SCIENCE ABSTRACTS.

Section A.—PHYSICS.

APRIL 1904.

GENERAL PHYSICS.

691. *Instrument for Measuring Lateral Contraction of Tie Bars, and the Determination of Poisson's Ratio.* **J. Morrow.** (Phys. Soc., Proc. 18. pp. 582–590; Discussion, pp. 590–591, Dec., 1903.)—The author's instrument consists of a pair of levers pivoted together, and arranged to support a pair of hardened set-screws, which are pressed by springs against opposite sides of the test piece. The other ends of the levers support a mirror on three needle-points, and a second mirror, close to the first, is adjustably attached to one of the levers; the two reflections of a scale are read against one another by means of a telescope. The following values are obtained for Poisson's ratio, by tensile tests only, on specimens having diameters in some cases about 1 in., in others about ¾ in.: mild steel, 0·271 to 0·281; wrought iron, 0·270 to 0·289; drawn brass (Muntz metal), 0·320 to 0·351; drawn copper, 0·310 to 0·340; cast iron, 0·228 to 0·270. In the *discussion,* **Chree** thought the term Poisson's ratio inapplicable to cast iron, as it does not obey Hooke's law.

F. R.

692. *Electrical Foucault Pendulum Systems.* **E. K. Adams.** (Elect. World and Engineer, 43. pp. 211–215, Jan. 30, 1904.)—In this paper some electrical methods of maintaining the amplitude of vibration of a Foucault pendulum are described. The acceleration is supplied by the electric force between two coils of different diameters, the smaller being incorporated in the bob of the pendulum with its axis in the line of the suspension, while the larger is mounted in a horizontal position underneath the pendulum with its axis in the line of suspension of the pendulum when in its central position. It has been found experimentally that when direct or alternating currents flow in the two coils in the same direction, the pendulum coil is urged towards the centre of the large coil whatever be the plane of oscillation, the force being strongest when the small coil is directly over a portion of the large coil. Current is supplied to the small coil by twin wires brought down from the knife-edge suspension of the pendulum. The electrical circuit contains the two coils and a key, all in series, and by closing the key when the bob is over the perimeter of the large coil, the necessary force to maintain the full swing of the pendulum is supplied. The system may be modified in various ways, and the author gives detailed descriptions of two modifications which are automatic in action. In one of these an induction coil is used, whose secondary circuit is automatically closed by the bob whenever it comes over a portion of the large coil at the end of its swing, so that the accelerating force is supplied without the intervention of an operator to close the key used in the first scheme. The other modification consists in providing a controlling contact mechanism which is adjusted in synchronism with the pendulum and sends impulses of current through the coils at the proper moment.

W. C. H.

693. *Surface Tensions of Mixtures of Ethylic Alcohol and Water.* **M. Descudé.** (Journ. de Physique, 2. pp. 348–351, May, 1903.)—These experiments are made upon mixtures of strengths 10, 20, 30, 40, 50, 60, 70, 80, 90, 100, as measured by the legal French alcohol hydrometer. The temperature is 15°, and the method is the ordinary capillary-tube procedure. The radius of the tube is about 0·278 mm., and the heights of rise range from 53·92 mm. for strength 0 (pure water) to 20·88 mm. for strength 100. A table of "capillary tractions" upon a mm. tube is given for all strengths, proceeding by 1 from 0 to 100. The intermediate values are obtained by interpolation from a curve which presents some interesting peculiarities.

J. W. P.

694. *Application of Lagrange's Equations to the Theory of Viscosity.* **L. Natanson.** (Acad. Sci. Cracovie, Bull. 5. pp. 268–283, May, 1903.)—In the author's theory p_{xx}, p_{yy}, p_{zz} are normal components, p_{yz}, &c., tangential components, of pressure with respect to the axes of x, y, z respectively, p pressure per unit of area, T the time of relaxation, and he obtains the fundamental equations—

$$\frac{d}{dt}(p_{xx}-p)+\frac{1}{\mathrm{T}}(p_{xx}-p)+2n\frac{\partial u}{\partial x}+\left(k-h-\frac{2}{3}n\right)\left(\frac{\partial u}{\partial x}+\frac{\partial v}{\partial y}+\frac{\partial w}{\partial z}\right)=0,$$

in which $\frac{d}{dt}$ stands for $\frac{\partial}{\partial t}+u\frac{\partial}{\partial x}+v\frac{\partial}{\partial y}+w\frac{\partial}{\partial z}$, u, v, w being components of velocity, and h, k, n the known constants of the theory given by Stokes. Also $\frac{dp_{yz}}{dt}+\frac{p_{yz}}{\mathrm{T}}+n\left(\frac{\partial w}{dy}+\frac{\partial v}{\partial z}\right)=0$, and two corresponding equations in y and z respectively. The equations in this form not being integrable, the author substitutes for x, y, z new variables $a\,(x, y, z, t)$, $b\,(x, y, z, t)$, $c\,(x, y, z, t)$, satisfying the conditions $\frac{\partial a}{\partial t}+u\frac{\partial a}{\partial x}+v\frac{\partial a}{\partial y}+w\frac{\partial a}{\partial z}=0$, and two corresponding equations. By this means the fundamental equation is reduced to the integrable form $\frac{\partial \phi}{\partial t}+\frac{\phi}{\mathrm{T}}+\Omega=0$, ϕ being an unknown, and Ω a known function of a, b, c, t. The same transformation is applied to the Lagrangean equations. In the latter part of the paper the author discusses the propagation of a very small motion through a viscous fluid, in continuation of a former memoir on the same subject (Bull. Int. de l'Acad. Sc. de Cracovie, d. d. Sc. Math. et Nat. Amér., p. 19, 1902.) [See Abstract No. 14 (1902).] He starts here from the relation $\frac{dp}{dt}=-h\left(\frac{\partial u}{\partial x}+\frac{\partial v}{\partial y}+\frac{\partial w}{\partial z}\right)$, leading to $\rho\frac{dp\rho}{d\rho}=h$, where h is a new constant. He refers to the reasons elsewhere given for holding that h is equal to k, the above constant of Stokes and St. Venant, though that relation is not essential to the problem treated in the present paper. He obtains, finally, an equation which is to be compared with equation (3), paragraph 6, of his memoir above cited.

S. H. B.

695. *Approximation of Certain Equations in the Theory of Viscosity.* **L. Natanson.** (Acad. Sci. Cracovie, Bull. 5. pp. 283–311, May, 1908.)—In this paper is contained the author's reply to two several objections made against his works by Zaremba. The first objection is as follows: The author gives the equations for the motion of a viscous fluid in process of relaxation in the form $\Phi = e^{-t/\mathrm{T}}\mathrm{C} - e^{-t/\mathrm{T}}\int dt\, e^{t/\mathrm{T}}\Omega$......(A), in which ϕ, Ω are functions of x, y, z, and t, C a function of x, y, z only. The form of these functions in no way affects Zaremba's first objection. Here x, y, z are the co-ordinates of a point in the fluid referred to axes Ox, Oy, Oz fixed in space, and T is the time of relaxation. Zaremba supposes a new set of axes Ox', Oy', Oz' always parallel respectively to Ox, Oy, Oz, but moving with constant velocities of translation λ, μ, ν relative to them, so that $x' = x - \lambda t$, &c., and if u, v, w denote the component velocities at x y z, u' v' w' the same velocities referred to the moving axes, $u' = u - \lambda$, &c. Zaremba assumes the motion of the fluid relative to the moving axes to be "parfaitement determinée," which the author understands to mean that the functions which express u', &c., in terms of x', &c., are independent of λ, μ, ν. Zaremba also says that the motion of the fluid relative to *the moving axes* is to be independent of λ, μ, ν. That is, the fluid has, in addition to the relative motions of its parts, the constant velocities λ, μ, ν. Therefore for the same point in the fluid, $x' = x - \lambda t$ is constant in time. Zaremba's objection now is that ϕ, being a function of x', &c., is a function of $x - \lambda t$, and therefore ought to satisfy the condition $t\frac{d\phi}{dx} + \frac{d\phi}{d\lambda} = 0$. But he says the second term on the right-hand side of A does not, and therefore ϕ does not, satisfy the condition. That is, he says that $te^{-\frac{t}{\mathrm{T}}}\int e^{\frac{t}{\mathrm{T}}}\frac{d\Omega}{dx}dt + e^{-\frac{t}{\mathrm{T}}}\int e^{\frac{t}{\mathrm{T}}}\frac{d\Omega}{d\lambda}dt = 0$ generally. Therefore he says that the author's equation A must be erroneous. It would seem, however, that since $e^{\frac{t}{\mathrm{T}}}\Omega$ is a function of $x - \lambda t$, and $x - \lambda t$ is constant, it is the same function of $x_1 - \lambda t_1$, if t_1 is the superior limit of the t integration, *i.e.*, the present time, and x_1 the value of x corresponding to it. Every member of the integral is thus a function of $x_1 - \lambda t_1$. Therefore the integral itself $\int e^{t/\mathrm{T}}\Omega dt$ is a function of $x_1 - \lambda t_1$. Therefore the integral satisfies the condition—

$$\left(t_1\frac{d}{dx_1} + \frac{d}{d\lambda}\right)\left(\int e^{t/\mathrm{T}}\Omega dt\right) = 0$$

in the only sense in which the condition is true, namely, when t and x refers to the same time. Zaremba obtains a contrary result by using different values of t with the same x. If this reasoning be sound, Zaremba's first objection requires no further answer. The author, however—and his authority is a very high one—does not accept this reasoning. He admits that Zaremba's condition is not exactly satisfied, and bases his own reply to the first objection on the approximate character of equation A, which is derived from a fundamental equation in which $\frac{\partial\phi}{\partial t}$ is used as an approximation instead of $\frac{\partial\phi}{\partial t} + u\frac{\partial\phi}{\partial x} + v\frac{\partial\phi}{\partial y} + w\frac{\partial\phi}{\partial z}$. This introduces Zaremba's second objection, which is that the above approximation is not legitimate. It is, however, defended by the author at considerable length in the second part of this paper.
S. H. B.

696. *Experimental Determination of the Instantaneous Pressure the Result of Impact.* **Ringelmann.** (Comptes Rendus, 137. pp. 644–645, Oct. 27, 1903.) —The author has devised an experimental apparatus for determining the pressure, C, which exists momentarily between a mass P, and a fixed body, when P falls from a certain height, H. Using various weights of from 100 to 600 gm., falling through distances 0·5 to 2 m., the pressures were recorded on a dynamometer. The results obtained show that if *v* is the velocity of the body in metres per sec. before impact, *k* an experimental coefficient (found to be 13·55), and C the instantaneous pressure resulting from the impact, then $C = kPv$. The value of *k* can be taken as that given, certainly within 2 per cent. The author finds that the value obtained by Poncelet in his *Mecanique Industrielle* (*i.e.*, 66), would, when obtained by this formula, be 68·427.

L. H. W.

697. *Bending of Magnetometer Deflection Bars.* **C. Chree.** (Phil. Mag. 7. pp. 39–45, Jan., 1904. From the National Physical Laboratory. Communicated by the Physical Society.)—In a previous paper [see Abstract No. 653 (1902)] the author pointed out the application of elastic solid equations to metrology, and in the present paper has worked out the results in the case of a deflecting magnetometer where the weight of the deflecting magnet causes an increase of the distance between the deflecting and deflected magnets. To determine the compensation necessary equal weights are placed symmetrically on each arm of the magnetometer. This causes an increase of distance between the magnets and consequently a decrease in the deflecting force. The change in the deflecting angle (u) for a change in the distance (r) is given by $\delta r = -1/3\, r \operatorname{Cot} u\, \delta u$. From the values of δr the values of EI are obtained, where E = Young's modulus and I = moment of inertia for the bar. The author gives results obtained at the National Physical Laboratory for typical bars made by Cooke, Dover, Elliott, and the Cambridge Scientific Instrument Co.

E. S. A. R.

698. *Cause of the Earth's Internal Heat.* **G. Romanes.** (Roy. Soc. Edinburgh, Proc. 24. pp. 415–420. Notes by **A. Gray** and **C. G. Knott,** pp. 420–422, 1902–1903.)—The author works out graphically and by a process of averages, the theory, first enunciated by Helmholtz, that the gravitational contraction of the components of the earth would generate sufficient heat—without help from collisions—to produce its present state as to temperature, and he estimates the pressure at the centre of the earth as about 500 million atmospheres. Knott calculates that a contraction of the earth by a fraction of a foot in 1,000 years would compensate its loss of heat by radiation. Gray makes a similar calculation with the assumption of a linear law of variation of the earth's density, and concludes that a contraction of 1 cm. would supply the heat radiated in 340 years. [His expressions for the exhaustion of potential energy in building up a sphere by matter brought from a distance and its rate of variation with the radius of the sphere are not compatible.]

R. E. B.

699. *Rationality of an Experimental Law of H. Parenty for the Efflux of a Gas through an Orifice.* **J. Boussinesq.** (Comptes Rendus, 138. pp. 29–34, Jan. 4, 1904.)—In the first part of the paper the author gives the theory, first worked out by de Saint-Venant and Wantzel in 1839 and completed in 1886 by Hugoniot and Osborne Reynolds (the latter of whom the author omits

to mention) of the adiabatic efflux of a gas through an orifice in a thin wall. This theory leads to the expression $\sqrt{2\frac{P_0}{\rho_0}}\sqrt{\frac{n}{n-1}\left\{(1-\Delta)^{\frac{2}{n}}-(1-\Delta)^{\frac{n+1}{n}}\right\}}$ for the efflux per sec. per unit of section of the vena contracta, expressed as a volume of gas measured at the pressure and temperature of the reservoir *from* which the gas is flowing. In this expression, $n =$ ratio of specific heats of gas, $p_0 =$ pressure of quiescent gas in reservoir, $\rho_0 =$ corresponding density, and $\Delta = \frac{p_0 - p}{p_0} =$ relative expansion, p being the pressure of quiescent gas in the receiver *into* which the gas is flowing. The author now shows by expansion in series of the expression $\left\{(1-\Delta)^{\frac{2}{n}}-(1-\Delta)^{\frac{n+1}{n}}\right\}$, that in the case of gases where we can write $n = 1{\cdot}4 = \frac{7}{5}$, the expression for the efflux reduces very approximately to the form $\sqrt{2\frac{P_0}{\rho_0}}\sqrt{\Delta(1-\frac{15}{14}\Delta)}$, that is to say, the curve expressing the relation between efflux and Δ is an almost circular ellipse. This result is exactly that to which Parenty was led by his experiments. F. G. D.

700. *Interpretation of Milne Seismograms.* **C. C. Farr.** (Phys. Soc., Proc. 18. pp. 579–581; Discussion, pp. 581–582, Dec., 1903.)—The author points out the errors in deriving information regarding the movement of the earth from the measurement of a Milne seismograph, owing to the effect of synchronism. In some cases the error may be obtained by driving the tape at a faster rate or by noting the interference effects between the forced and free vibrations of the boom. The author describes his own experiments with a loaded pillar. **R. T. Glazebrook** said the paper showed the possibility of interference between the periods of the boom and the earthquake tremors. **J. Perry** said that if possible the period of the pendulum should be very different from that of the wave. **J. D. Everett** suggested the use of two booms with different periods. **W. Watson** pointed out that the boom would respond equally well to any period if heavily damped, *e.g.*, by fixing a copper plate at the end and causing it to pass between the poles of a strong horseshoe magnet. **C. Chree** said the apparatus became too sensitive if the boom's period exceeded 18 secs. E. S. A. R.

701. *Deflections of the Plumb-line in India.* **O. Fisher.** (Phil. Mag. 7. pp. 14–25, Jan., 1904.)—The author assumes a cross-section of 124 miles for the Himalaya range, the plateau of Tibet to be 400 miles across and 3 miles high, and the mass to have accumulated out of the compression of a crust 25 miles in thickness, the root of the plateau dipping 29 miles into the substratum. The deflection of the plumb-line at the foot of the slope should then be: 39″ due to the slope, 44″ due to the plateau, the negative deflection due to the "root" 68″, and therefore the residual deflection towards the range about 15·7″. At 60 miles from the foot, the residual deflection towards the range would be 1·1″, at 293 miles (Kalianpur), 0·185″ away from the range. But though general continental elevations are compensated by a deficiency of density below sea-level, local irregularities may be maintained by the rigidity of the earth coast (Putnam). Accepting Oldham's views of the geology of the district, and assuming the range and plateau to be supported both by the "root" immediately beneath them and also by the depressed crust beneath the Sivalik rocks of the plains, the three residual deflections would be: 23·7″,

1·86″ (towards) and 2·3″ (away from the range). Considering finally that the Himalaya does not cross the meridian of Kalianpur at right angles, but under 40°, the figures would agree still better with Burrard's. The author had for his computations the assistance of A. R. Hinks and Bell. H. B.

702. *Estimation of Dissolved Gases in Sea-water.* **E. Ruppin.** (Zeitschr. Anorg. Chem. 38. 1. pp. 117–120, Jan. 2, 1904. From the Kiel Laboratorium für internationale Meeresforschung, Hydrographische Abteilung.)—Some difficulty is encountered in estimating carbon dioxide, as it requires to be swept out by means of an inert gas like hydrogen, whilst the addition of acid introduces a further error, owing to the absorption of oxygen by the mercury used to produce a vacuum. The analysis can, however, be carried out in Kundsen's apparatus if a correction of 1 per cent. is applied to allow for the last residues of carbon dioxide, which cannot be extracted. The carbon dioxide can also be completely determined if it is swept out by means of a small amount of hydrogen at a temperature not below 90°, but this is more troublesome than the preceding process. A sample analysis gave in the case a sea-water containing 2·1 per cent. of salt, 40·38 c.cm. CO_2, 11·68 c.cm. N_2, and 5·92 c.cm. O_2 (per litre ?). T. M. L.

703. *Origin of Spiral Nebulæ.* **J. M. Schaeberle.** (Nature, 69. pp. 248–250, Jan. 14, 1904.)—The author suggests that spiral nebulæ have their origin in two enormous discharges of gases from points diametrically opposite to one another on the surface of a rapidly rotating star. According to this view, as a star cools down, its outer surface becomes more or less plastic, and blow-holes are continually being formed. As the star gets cooler, the surface finally becomes solid, and the blow-holes are no longer formed; after a time, however, owing to contraction, the internal pressures become sufficiently great to break through the surface. The outrush of matter is large enough to carry most of the particles beyond the region of sensible attraction of the parent mass. When the first explosion takes place, a second one, due to the reaction, follows at a point diametrically opposite upon the star's surface. If these two points lie upon the equator, and the star is rotating, a spiral nebula will result; if, however, they are not upon the equator, various complex helices will be formed. E. C. C. B.

REFERENCES.

704. *Surface Tension.* **G. Guglielmo.** (Accad. Lincei, Atti, 12. pp. 462–471, Nov. 22, 1903.)—The author gives a number of values obtained for the surface tension of water by experiments on drops and bubbles, and discusses the disagreements existing between observed and calculated values. J. E.-M.

705. *Diffusometer.* **J. Thovert.** (Comptes Rendus, 137. pp. 1249–1251, Dec. 28, 1903.)—A continuation of a description of a method of measuring rates of diffusion by observation of the rate of change of refraction of a ray of light passed through the liquid [see Abstract No. 500 (1903)]. The method gives very concordant results if the solutions are of not more than 1 per cent. concentration. J. E.-M.

706. *Continuous Deformation of Surfaces.* **G. Tzitzéica.** (Comptes Rendus, 138. pp. 553–554, Feb. 29, 1904.)—A mathematical note on this problem in infinitesimal geometry. J. W. P.

707. *Rapidity of the Nervous Impulse in Tall and Short Individuals.* **N. H. Alcock.** (Roy. Soc., Proc. 62. pp. 414–418, Dec. 19, 1903. From the Physiological Laboratory, University of London.)—The results on the human subject agree with those obtained from the frog. Per unit length, the rate of the nervous impulse is the same in all individuals examined. The time taken to traverse the limb nerves in a tall man is therefore appreciably longer than in a short man. The mean velocity, deduced from forty experiments, is 66·8 m. per sec. H. W. P. Y.

708. *Joining Quartz Receivers to Mercury Pumps.* **J. Elster** and **H. Geitel.** (Phys. Zeitschr. 5. pp. 33–34, Jan. 15, 1904.)—In the use of quartz tubes for physical work two difficulties are met with, viz., the difficulty of sealing on to the pump and the sealing in of electrodes. Figures are given illustrating methods by means of which these objections may be removed. They consist essentially of mercury seals. When electrodes are required, they are fused into glass tubes, and these tubes are joined to the quartz vessels. R. S. W.

709. *Osmosis.* **A. Guillemin.** (Comptes Rendus, 138. pp. 38–40, Jan. 4, 1904.)—The author does not like the equation $z = \frac{67\cdot165}{8} \mathrm{T} \log \frac{f}{f'}$ (which gives the osmotic rise z in a vertical osmometer) because it does not apply to other osmometers where the balancing hydrostatic pressure in the solution is not produced by gravitation ! He therefore develops the concept "tension of expansibility," or tendency to emit vapour, of a liquid, and finds consolation in picturing the equilibrium at the semipermeable wall as due to the equality of these tendencies, that of the solution being raised up to the value of the pure solvent outside by the increase of its vapour-emitting tendency, caused by the pressure to which the solution is subjected. (The author has evidently not read the work of Lewis.) F. G. D.

710. *New Form of Dipleidoscope.* **H. Grubb.** (Roy. Dublin Soc., Proc. 10. 13. pp. 141–142, Feb. 10, 1904.)—An instrument for finding correct local time. It consists of a right-angled prism fixed so that two images of the sun, when near meridian, are thrown on a screen, one by direct reflection, the other by double internal reflection. The images move in opposite directions, and overlap at the instant the sun is on the meridian. When accurately set it can be relied upon within one second. H. F. H.

711. *Friction at a Pivot.* **L. Lecornu.** (Comptes Rendus, 138. pp. 554–557, Feb. 29, 1904.)—The resisting couple due to sliding friction at the small area of contact of two bodies, one of which is rolling on the other, is considered. Léauté had shown this couple proportional to the length of the ellipse of contact. This result is investigated and verified. The view of Herz, in opposition to this, is considered. J. W. P.

712. *La Soufrière and Mont Pelée.* Part I. **T. Anderson** and **J. S. Flett.** (Roy. Soc., Phil. Trans. 200. pp. 353–553, March 9, 1903.)—This is a very fully illustrated report, an extension of the preliminary paper dealt with in Abstract No. 997 (1903). G. W. DE T.

713. *Remarkable Sunsets and Sunrises at Bordeaux, Winter,* 1902–1903. **Esclangon.** (Comptes Rendus, 136. pp. 1050–1052, May 4, 1903.)—More than sixty observations have been made [see Abstract No. 617 (1903)], the phenomenon being frequent, yet very capricious. The sky was clear ; only for about 5 or 10 min. very delicate cirrus clouds could be observed, at altitudes of generally 10 km., varying between 5 and 25 km. The assumption of volcanic dust would not fully explain the phenomenon, certainly not its capricious character. H. B.

714. *The Cold Days, May* 10 *to* 13. **R. Gautier** and **H. Duaime.** (Archives des Sciences, 15. pp. 545–557, May, 1903.)—According to Plantamour the days May 10 to 12 are, in Geneva, not colder than those preceding and following. But he took mean temperatures instead of minima, and groups of five days. Müttrich, and also von Bezold, found night frosts particularly frequent on the days May 10 to 13 of the period 1878–1894; Kremser confirmed this for that period, but not for 1848–1878. The authors, taking like Bezold and Kremser groups of three days, have analysed the temperature records of Geneva since 1799. The days May 11 to 13 were cold in the years 1826 to 1850, but not in the latter half of the century; cold spells may occur throughout May, but there is no regularity or periodicity in the phenomenon, which Kremser likewise failed to find. H. B.

715. *The Sun-spot Period and Terrestrial Temperature.* **C. Nordmann.** (Comptes Rendus, 136. pp. 1047–1050, May 4, 1903.)—According to Köppen, 1873, there is a certain inverted parallelism between the sun-spot and the mean annual temperature curves, but only for the tropical regions. The author examines the records of the period 1870 to 1900 for thirteen stations in the tropical zone, and confirms Köppen entirely; years of sun-spot maxima were cold, of minima warm. H. B.

716. *Mass Distribution on the Earth Surface.* **G. Lippmann.** (Comptes Rendus, 136. pp. 1172–1173, May 18, 1903.)—According to Faye the attraction of the continental masses does not affect the pendulum because the cooling action of the ocean water thickens the earth's crust at the sea bottom. Lippmann suggests that the flexibility of the crust and buoyancy explain the observation; the crust floats on the fused mass underneath, and there is sufficient buoyancy when large areas are considered, though not for local features, for which corrections have to be applied. H. B.

717. *Sun-spots and Terrestrial Temperature.* **A. Angot.** (Comptes Rendus, 136. pp. 1245–1246, May 25, 1903.)—For the Jacob Camp on Guadeloupe the formula $t = t_0 + ar$, where r is Wolf's sun-spot number, t the mean annual temperature, and t_0 and a are constants, gives for the period 1892 to 1901 mean annual temperatures which do not differ by more than 0·17° from the observed means. The value of a is 0·89°—four times greater than the probable error. H. B.

718. *Log Line.* **E. Guyou.** (Comptes Rendus, 136. pp. 1170–1172, May 18, 1903.)—The author has devised a log line for high-speed steamers. It consists of a sack of calico, stretched over a ring of cane and containing some sand, and four balls of a line of cheap material which may be sacrificed. The balls are unrolled, the one after the other, so that no large-size drum is needed, and the speed is electrically recorded. An accuracy of 1 per cent. has been attained. H. B.

719. *The Telephone in Weather Bureau Work.* **H. M. Gage.** (American Telephone Journ. 8. pp. 371–372, Dec. 5, 1903.)—Extensive use is made of the telephone in circulating the forecasts of the U.S. Weather Bureau. C. F. Marvin and J. H. Robinson have made arrangements by means of which two observers can take simultaneous cloud observations with the aid of telephones. H. B.

720. *Earthquakes in the Southern Andes.* **de Montessus de Ballore.** (Comptes Rendus, 138. pp. 106–108, Jan. 11, 1904.)—The author discusses the distribution of seismic instability in the Andes between latitude 16° and 56° S. after Goll's seismic catalogue of Chili, which is itself largely based on Dessauer's notes. The origin of the seismic disturbances is probably submarine; there is no connection with volcanic phenomena. H. B.

721. *Solar Observations at the Lyons Observatory during the Second Quarter of* 1903. **J. Guillaume.** (Comptes Rendus, 137. pp. 431–432, Aug. 24, 1903.) [See also Abstract No. 490 (1904).]

722. *Bathymetrical Ocean Chart.* **J. Thoulet** and **C. Sauerwein.** (Comptes Rendus, 138. pp. 109–110, Jan. 11, 1904.)—In accordance with the resolutions of the Berlin Geographical Congress of 1899, a bathymetrical chart in 24 sheets on the scale 1 : 10,000,000 has been prepared by Sauerwein after Thoulet's suggestions. Mercator projection is adopted for the zones between the equator and latitude 72°, and a gnomonical projection for the polar caps. All the soundings available in July, 1903, have been recorded. H. B.

723. *Sun-spots and Terrestrial Magnetism.* **H. Deslandres.** (Comptes Rendus, 137. pp. 821–827, Nov. 23, 1903.)—From an examination of the data available the author concludes that the connection between sun-spots and terrestrial magnetic storms is not by any means so well established as has been supposed. Considerable magnetic storms have occurred when no spots were visible, and the magnitudes of spots and storms which have been simultaneous are frequently in inverted order, *i.e.*, large storms have accompanied small spots, and *vice versâ.* Sufficient data are not available, and the author advocates a much more thorough and continuous observation of the sun's surface and chromosphere. J. E.-M.

724. *Comet,* 1903, *cIV. Observations made at Rome.* **E. Millosevich.** (Accad. Lincei, Atti, 12. pp. 343–344, Nov. 8, 1903.)—A record of forty-three observations of the position of the comet between June 23 and August 22, 1903. J. E.-M.

725. *Sun-spots of October,* 1903. **E. W. Maunder.** (Knowledge, 26. pp. 275–278, Dec., 1903.)—Three groups of spots were noticed in October, and partly again in November, and the crossing of the central meridian of the sun by the spots was in each case more or less simultaneous with magnetic disturbances. But a quantitative relation does not exist. The first spot was of quite exceptional size, the magnetic disturbance of second rank ; the second spot was of the second rank, but the magnetic disturbance (of October 31) of most unusual intensity ; the third spot was very large again, but the magnetic phenomena were altogether insignificant. The paper is illustrated. H. B.

726. *Internal Oscillation in the Waters of Loch Ness.* **E. R. Watson.** (Nature, 69. p. 174, Dec. 24, 1903.)—Taking the water temperatures at different depths several times daily, from July to October, the author finds a distinct fluctuation in the temperature curves for depths between 100 and 300 ft. For the depth of 200 ft. the difference between the maximum and minimum temperatures is 5° F., and the period three days ; for greater depths the difference is smaller, but period and phase are the same. The author suggests an internal seiche, due to the formation of a layer of light, warm water floating on the cold water, and started by the wind. H. B.

727. *Temperature of the Higher Atmosphere.* **L. Teisserenc de Bort.** (Comptes Rendus, 138. pp. 42–45, Jan. 4, 1904.)—The author gives a summary of five years' observations in the vicinity of Paris, distinguishing the 141 balloon ascents which reached altitudes of 14 km. from the 581 which went up to 10 km. In the lower strata the temperature decrease is slow. At altitudes of 3 or 4 km. temperature inversions are frequent at night-time, and also in daytime above cloud banks (Assmann and Berson). With general atmospheric movements the temperature decreases adiabatically up to 10 or 11 km., when, in the so-called isothermal zone, the temperature rises again a little, or keeps constant ; this renewed inversion has been observed throughout the year. H. B.

728. *The New Bishop's-ring and Atmospheric Circulation.* **A. L. Rotch.** (Nature, 68. p. 623, Oct. 29; 69. pp. 173–174, Dec. 24, 1903.) **F. A. Forel.** (Nature, 68. p. 396, Aug. 27, 1903. From the Gazette de Lausanne.)—Rotch observed the ring on the Mont Blanc in August, 1903, and comments upon the observations of Clayton, at Blue Hill, and of Forel. The last note concerns an article by Forel, in the Gazette de Lausanne, on observations in the Alps. [See also Abstract No. 495 (1904).] H. B.

729. *Ice-breakers and their Services.* **A. Gulston.** (Soc. Arts, Journ. 52. pp. 215–227; Discussion, pp. 227–228, Jan. 29, 1904.)—A brief account of the ice-breakers and their work, especially in Russia, Denmark, Sweden, and Norway, Germany, the United States and Canada. Remarks were made by **F. Elgar** and **F. J. Trewent.** H. B.

730. *Rainfall Chart of the Meteorological Office, London.* (Nature, 69. p. 231, Jan. 7, 1904.)—On January 1 a subsidiary chart was issued giving the total rainfall for 1903 from those stations which report by telegraph, and the percentages of the average fall for the 35 years 1866 to 1900. The greatest fall in 1903, 67 in. at Valencia, is 120 per cent. of the yearly average; London has the greatest excess, the 38 in. measured representing 156 per cent. of the average. H. B.

731. *Quadrantid Meteor Shower of* 1904. **J. R. Henry.** (Nature, 69. p. 272, Jan. 21, 1904.)—The shower was observed at Dublin so far as the full moon and, later on, clouds permitted, the two maxima calculated for 13 h. and 18 h. G.M.T., January 3, being distinctly separated by an interval of meteoric paucity. H. B.

732. *Diminishing Size of the Bishop's-ring around the Sun.* **H. H. Clayton.** (Nature, 69. pp. 270–271, Jan. 21, 1904.)—When first observing the Bishop's-ring, in August, 1902, Backhouse found the mean distance from the sun to be 70°. During the author's own observations, in the course of 1903, the mean distance decreased gradually from 32° to 20°. H. B.

733. *Fire-balls in January.* **W. F. Denning.** (Nature, 69. p. 310, Jan. 28, 1904.)—Fire-balls have in recent years become noteworthy for January, especially on the days January 6 to 15 and January 23 to 29. There were seven this January, and they have generally slow, long and nearly horizontal flights. H. B.

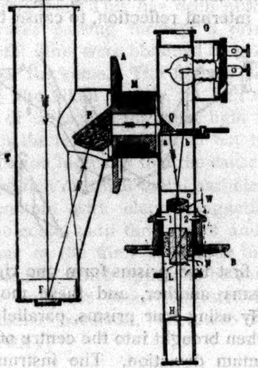
734. *Escape of Gases from Atmospheres.* **G. J. Stoney.** (Nature, 69. pp. 247–248, Jan. 14, 1904.)—A short account of the data upon which the author has based his calculations of the escape of gases from the earth's atmosphere. These are four in number. First, there is no atmosphere round the moon, and therefore, as can be shown, free hydrogen must be able to escape from the earth. The second and third facts are that hydrogen and helium are being continually given up by the earth, and yet neither gas has gone on accumulating in the atmosphere. It is therefore inferred that the escape of these gases just balances the supply from the earth. The fourth datum is that the earth's potential of gravitation is sufficient to prevent any sensible escape of water vapour from the atmosphere. E. C. C. B.

735. *Presence of Formic Aldehyde in the Atmosphere.* **H. Henriet.** (Comptes Rendus, 138. pp. 203–205, Jan. 25, 1904.)—The author has proved that this powerfully antiseptic gas exists in the atmosphere to an extent which varies between 1 part and 5 parts in 100,000 by weight, and is dependent upon the temperature. Its presence has an important bearing on the hygienic purity of the air. J. D. C.

736. *Antarctic Expeditions.* (Nature, 69. pp. 393–395, Feb. 25, 1904.)—A brief account of the results of the Swedish, Scottish, and German expeditions, with small map of their routes. H. B.

LIGHT.

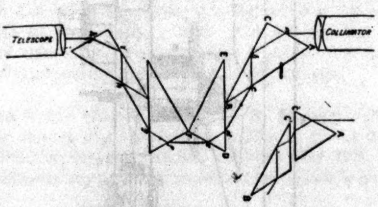
737. *Portable Photometer.* **F. F. Martens.** (Deutsch. Phys. Gesell., Verh. 5. 7. pp. 149–156, April 15, 1903.)—The instrument has a tube T which can be rotated about a horizontal axis. Each end of the tube is fitted with three covers: one contains a plaster-of-Paris screen, a second has a small circular aperture, and the third has a wide opening covered with a piece of frosted opal glass. On the right-hand side of the instrument is the incandescent lamp, which is used as a standard, taking 0·3 ampere and 4 volts, and the polarising photometer, which consists of a rotatable nicol, the angle through which it is turned being read on a scale fixed to the instrument. The author describes the way in which various measurements can be made with the instrument. W. H. S.



738. *Position of the Diaphragm in Central Optical Systems of Finite Aperture.* **A. Gleichen.** (Deutsch. Phys. Gesell., Verh. 5. 9. pp. 193–203, May 15, 1903.)—The name "centre of the natural diaphragm" is given to that point where principal rays of small inclination cross one another. Taking for example the simple case of a single convex lens, the locus of the caustic cusps, for rays of a given inclination to the axis, cuts the axis at a point which varies with the inclination, but for small inclinations may be regarded as fixed. The usual plan pursued in seeking the situation of the image formed by an optical system, is to trace the course of principal rays of various inclination which pass through the centre of the "entrance pupil," and to determine the position upon them of the foci for meridional and sagittal rays. The assemblage of these points constitutes the pair of so-called astigmatic image surfaces. But the position of the entrance pupil is arbitrary, and in general does not agree with the centre of the natural diaphragm above mentioned. The author emphasises the fact that to obtain accuracy the latter point, not the former, must be taken as origin in the trigonometrical calculations, and further, in the case of rays of large inclination to the axis, the non-fixity of the diaphragm must also be considered. A particular case is taken and illustrated. The author investigates the position of the centre of the natural diaphragm for the general case of a central system with any number of refracting surfaces. The resulting formulæ are too lengthy for quotation.

A. E.

739. *Direct-vision Spectroscope of one Kind of Glass.* **T. H. Blakesley.** (Phys. Soc., Proc. 18. pp. 507–509; Discussion, pp. 509–510, Nov., 1903.)—This instrument has a four-prism system. The first and fourth prisms may be considered to be made up of two smaller ones as AC, C′B, of which AC conforms to the condition that the refracting angle is equal to the deviation, and C′B serves, by an internal reflection, to cause the rays to change sides.



The collimator and the first two prisms form one rigid system, the telescope and the last two prisms another, and these move relatively about the symmetric point F. By using four prisms, parallelism and collinearity are secured, and any ray when brought into the centre of the field passes through the prisms with minimum deviation. The instrument as constructed, in which the two middle prisms are curtailed, gives admirable visibility from the lines A to H, and the dispersion between A and G is 18° 20′. G. E. A.

740. *Magnetic and Electric Dichroism.* **G. Meslin.** (Comptes Rendus, 136. pp. 1059–1061, May 4, 1903.)—With reference to his previous observations [see Abstract No. 68 (1904)], the author finds that the description of the appearances can be simplified by forming a table containing in order the different solids and liquids concerned, so arranged that every grouping of a solid and of a liquid gives a fluid with negative dichroism if the solid is before the liquid, and one with positive dichroism if it comes after it. The value of the index of the substance must also be taken account of in the table; then placing opposite each body its number of order and its index, and forming the product of the differences of the numbers and the differences of the indices, the algebraic sign of this product will indicate the sign of the dichroism. The phenomena are thus seen to be analogous to those of paramagnetism and diamagnetism. The liquid contains in suspension crystalline lamellæ more or less magnetic with regard to it, so that in the field of an electromagnet they behave as para- or diamagnetic. There are two cases which occur: (1) Magnetic particles, where all the axes set themselves parallel to the field; anisotropic structure exists which produces birefringence and dichroism in the general sense of the term. (2) Diamagnetic particles; the axes place themselves perpendicularly to the field, which is generally not uniform. If the solid is the more refracting, the case of negative dichroism arises, and the inverse result occurs when the solid has less refractivity than the liquid. By microscopic examination the author has proved the presence of minute crystals in the form of little tables in the active liquids. J. J. S.

741. *Electrical Resonance of Metal Particles for Light Waves.* **R. W. Wood.** (Phys. Soc., Proc. 18. pp. 515–523, Nov., 1903.)—Further experiments have been made which appear to confirm the provisional hypothesis of electrical resonance, which was adopted to explain the very brilliant colours of films made up of metal granules of the order of magnitude of light-waves. [See Abstract No. 470 (1903).] The coloured films have been obtained in prismatic form, and the fact has been established that they exhibit anomalous dispersion for waves longer and shorter than the ones which are refused transmission. This has been observed by other investigators for electrical waves passing through a prism built up of tinfoil resonators. Suitable metal films were obtained on glass on which was a film of gelatine of infinitesimal thickness. The films of silver showed the same peculiarities as those of the alkali metals. A film of prismatic form was obtained, and the index of refraction for violet light was found to be nearly unity, while the index for the red waves turned out to be 3·15. The occurrence of anomalous dispersion indicates that the cause of colour is resonance, but this resonance may be that of small metal particles and analogous to that obtained by tinfoil resonators with electro-magnetic waves, or it may be resonance within the molecule, as in the case of aniline dyes. The author has studied the behaviour of the films at oblique incidence with polarised light and has obtained results which appear to be concordant among themselves. The appearance in some cases suggested that something of the nature of multiple resonance occurred. [See also Bock, Abstract No. 275, and Lischner, No. 530 (1904).] J. J. S.

742. *Theory of the Mariotype and Ozotype Processes.* **T. Manly.** (Photographic Journ. 43. pp. 301–309; Discussion, pp. 309–310, Dec., 1903.)—After stating the conditions under which a chromium compound is sensitive to light, the reducing action of light upon a dried surface of gelatine impregnated with potassium bichromate is followed. With reference to the ordinary carbon process, the results are summarised as follows: (1) The action of light on $2(CrO_3)$ + organic matter results in $Cr_2O_3 + O_3$; (2) the presence of a bichromate salt in excess adds a molecule or more of CrO_3 to the reduction product, Cr_2O_3, producing $Cr_2O_3(CrO_3)_n$; (3) the eliminated oxygen is taken up by the gelatine, but plays no part in the insolubilising action; (4) the CrO_3 attached to the Cr_2O_3 plays no part in the insolubilising action; (5) the Cr_2O_3 at the moment of its formation forms a definite combination with the gelatine, and renders it insoluble. The "continuing action" of light is explained by the motion of the CrO_3 molecule from the insoluble image further into the gelatine in which it is soluble, and its reduction to Cr_2O_3, another molecule of CrO_3 being at the same time withdrawn from the excess of potassium bichromate present in the film. The action is a spreading one, and would in time render the whole film insoluble. The Mariotype process is explained by means of the above action. In the Ozotype process the action of light upon potassium bichromate, when manganous sulphate is present, produces an image, of which the most insoluble part is represented by $MnOCrO_3 + Cr_2O_3(CrO_3)_n$ + oxidised organic matter. The ferrous sulphate and sulphuric acid bath produces the following reaction;

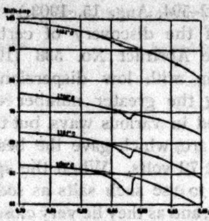
The CrO_3 is released by the acid, and rearrangement takes place thus—$2\,CrO_3 + 6\,FeSO_4 + 6\,H_2SO_4 = Cr_2O_3 \cdot 3SO_3 + 3\,Fe_2(SO_4)_3 + 6\,H_2O$. This product contains two of the most energetic inorganic tanning agents known, a combination which instantly insolubilises gelatine. In the *discussion* which followed it was asserted that the oxidation of the gelatine plays a much more important part than that assigned to it by the author. G. E. A.

743. *Astigmatic Aberration.* **R. J. Sowter.** (Phys. Soc., Proc. 18. pp. 573–577; Discussion, p. 578, Dec., 1903.)—This paper is intended to furnish a simple explanation of some of the shadow phenomena observed by S. P. Thompson in his experiments on aberration of lenses. The author considers an astigmatic non-homocentric pencil of symmetrical form, on the assumption that the focal lines are at right angles to one another and to the axis of the beam. He also assumes that the section of the bounding surface of the beam is an ellipse. One selected section being assumed elliptical, it follows from the equation to the bounding surface (Heath, Geom. Optics, p. 161) that all sections are elliptical, the axes of the ellipses being parallel to the focal lines. On transferring the origin to the middle point of the primary focal line, the equation to the surface becomes $a^2(\delta-z)^2(\delta^2y^2-b^2z^2)+b^2\delta^2n^2z^2=0$, where $2a$ and $2b$ are the lengths of the focal lines, and δ the distance between them. Through any point on this skew surface one generator or ray can be drawn, viz., $x=a\cos\phi.(\delta-z)/\delta$, $y=b\sin\phi.z/\delta$. Here ϕ is the eccentric angle of the point where the ray cuts any elliptic section, δ being constant all along the ray. Thus, in investigating the shadow of an object in the beam, if the generator ϕ_1 cut the receiving screen at a point I, ϕ_1 is the eccentric angle of the point I in the ellipse on the screen. In the *discussion* which followed, **Everett** objected that generally the focal lines were not at right angles, nor were they straight lines. In the case of a lens at 45° to the axis of a pencil, the secondary focal line was nearer to parallelism with the axis than to perpendicularity, and the cross-sections at the secondary focal region for a narrow zone of the lens were figures of 8. **Glazebrook** thought the author's assumption that the surface can be generated by the motion of an ellipse needed justification. He showed how the results could be obtained without any such assumption. **Price** referred to a figure similar to the elliptic trammels. An infinite bar moves so that two determined points upon it move along two fixed straight lines which are not coplanar and need not be at right angles. Every other point of the bar moves in a curve of the second degree in a plane parallel to the two fixed lines. The surface described by this infinite bar is similar in character to that of an astigmatic pencil, being like a double cone with straight generators all passing through two non-intersecting straight lines. A. E.

744. *Optical Properties of Developed Lippmann Emulsions.* **F. Kirchner.** (Ann. d. Physik, 13. 2. pp. 239–270, Jan., 1904. Extract from the Leipziger Inaugural Dissertation.)—The properties of the emulsion differ considerably in the dry and wet states, the refractive index being reduced when the emulsion is saturated with water. The index was measured by finding the critical angle for a prism of flint glass coated on one face with emulsion. The dispersion was measured by coating a glass plate with a thin wedge of emulsion and noting the interference bands in monochromatic light. Absorption curves are also given. In general the absorption of brown silver varies in the inverse direction with the wave-length, green silver has a minimum about $\lambda = 540\ \mu\mu$, and blue silver a maximum about $\lambda = 600\ \mu\mu$. The silver

content of the emulsion was obtained by dissolving a known volume of emulsion in dilute hydrochloric acid to form a turbid liquid. The latter was compared photometrically with one for which the silver content was known. The theoretical section of the paper deals with the effect of absorption on the determination of the refractive index by total reflection and by interference. The change of property of the plate in the wet and dry states consists in a displacement of the absorption maximum and a change in its absolute value. Curves are given showing smaller absorption in the wet plates and a displacement of the maximum to one side or the other. G. E. A.

745. *Pyrometric Examination of Nernst Lamps.* **F. Kurlbaum** and **G. Schulze.** (Deutsch. Phys. Gesell., Verh. 5. 24. pp. 428–435, Dec. 30, 1903.) —The black temperature of a body is that at which for a given wave-length the black body has the same emissivity as the body under examination. With Nernst lamps different black temperatures are found, according as the work is done with red, green, or blue light. In examining a Nernst filament the light from a horizontal filament falls on the slit of the spectroscope, and immediately behind it is placed the black body. If the temperature of the filament is so regulated that it appears as bright as the black body in the green portion of the spectrum, it will appear much darker in the yellow and red. It has therefore for certain temperatures a selective emissivity in the green portion of the spectrum. This becomes very marked when the attempt is made to calibrate a Nernst filament by comparison with a black body. This comparison is made by throwing both lights at the same time on the slit, and regulating the current through the Nernst lamp until its contour disappears against the background. It may in this way be calibrated for use as a convenient substitute for a black body. The adjoined curves show the result of comparing a filament with a black body at four different temperatures, the abscissæ being the wave-lengths, and the ordinates the current taken by the filament. It will be noticed that at the lower temperatures the curves show a very marked hump for a wave-length of about 0·52μ. A method is indicated by which black temperatures up to 2,150° C. can be determined by using a rotating sector together with two Nernst filaments, one of which has been calibrated up to about 1,500° C. With a hollow Nernst filament, 22 cm. long and having an internal diam. of 1·3 cm., it was found that the radiation is optically that of a black body from temperatures of 1,400° C., as measured by the optical pyrometer. W. H. S.



746. *Simple Explanation of Talbot's Bands.* **A. Schuster.** (Phil. Mag. 7. pp. 1–8, Jan., 1904.)—These bands are observed in a spectrum when half the aperture of the pupil is covered with a thin plate of mica or glass inserted on the blue side. The author attempts to explain the want of symmetry, which causes the bands to appear only when the plate is introduced on one side, by considering a single indefinitely short luminous impulse. Suppose such an impulse, spreading out from a distant point, to strike a plane reflection grating normally. A lens placed in front of the grating, and having its focus at F, receives the luminous disturbance, the left-hand side of the grating being nearest the lens. Briefly recalling the visual illustration of the ordinary action of a grating when analysing white light, the question now is: "How can the impulses which succeed each other at F be made to interfere? Clearly only by retarding those which first reach F, or accelerating those which reach that point last. A plate of appropriate thickness, introduced from the left-hand side of the figure [where the grating is nearest the lens], can be made to answer the purpose. If, on the contrary, the same plate were introduced on the right-hand side, it would only retard those impulses which already arrive late, and therefore no interference could take place." An investigation of the best thickness for the plate follows. In the case where the spectrum is produced by a prism: "In the immediate neighbourhood of a given wave-length, the spectrum may be taken to be a normal one, and there can be no intrinsic difference between the bands seen in this case and those observed when a grating of the same resolving power is used." A. E.

747. *Line Spectrum of Sodium.* **H. Konen** and **A. Hagenbach.** (Phys. Zeitschr. 4. pp. 592–594, Aug. 15, 1903.)—In a recent paper Lenard has given an account of the discovery of certain new lines in the line spectrum of sodium [see Abstract No. 533 (1904)]. The authors have investigated this spectrum with low dispersion, and have succeeded in observing and measuring the greater number of these new lines. The sodium vapour was excited in various ways, but the new lines could only be found in the case of the arc, which gave the best results when fed with a current of 6–25 amperes at 72 volts. When the spectrum was to be photographed it was necessary to use such salts as sodium sulphide or bromide. The lines are very diffused, and as they lie very close to the diffuse subordinate series, an accurate determination of their wave-lengths was impossible. The wave-lengths as found were as follows:—

Series 1.	Series 3.
5531·7	(5675·92
5527·1	5670·40)
4913·5	4976·1
4910·1	4973·0
4633·1	4660
4629·4	uncertain

The second series of Lenard could not be photographed and measured; the first pair in the third series has already been measured by Kayser and Runge. The frequency differences of the four new pairs are 15·1, 12·4, 14·0, and 16·7 respectively, while that of the D lines is 17·2. The pairs of the first series above have apparently the same convergence frequencies as the old subordinate series, which seems as if they were connected in some way. If, in the series formula, m be put $=7$, then the calculation gives $\lambda = 4478$; this may be the line Lenard found at $\lambda = 447$, which, however, the authors could not find. [See also next Abstract.] E. C. C. B.

748. *Line Spectra of the Alkalies.* **H. Konen** and **A. Hagenbach.** (Phys. Zeitschr. 4. pp. 801–804, Nov. 1, 1903.)—A continuation of the investigation recorded in the preceding Abstract; attempts were made to find new lines similar to those of sodium in lithium, potassium, rubidium, and cæsium. Certain new lines were found in lithium, which do not belong to the known series; nothing new was noticed in potassium, and in the case of rubidium and cæsium new lines were discovered, all of which, however, belong to the known series. As sources the carbon arc, oxyhydrogen flame, and the electric spark were used, but no new lines were found in the spark spectra. In the case of lithium the following new lines were measured: 6240·8, 4636·04, 4149·1, and 3924, of which the second had been previously measured by Hagenbach [see Abstract No. 716 (1903)], and the last is of uncertain accuracy. These lines are all diffuse towards the red. These wave-lengths can be expressed by the formula $\frac{1}{\lambda} = 28538{\cdot}0 - 110034\,m^{-2} - 23306\,m^{-4}$, m being put equal to 3, 4, and 5; $m = 6$ gives 3927, and $m = 7$ gives $\lambda = 3804$. On account of the presence of the bright line $\lambda = 3795$ ($m = 7$ first subordinate series), this line could not be seen. The convergence frequency 28538 is sufficiently near that of the first subordinate series 28586 to justify the supposition that the two series converge for $m = \infty$, thus showing an analogy with sodium. *A priori* it is reasonable to expect that these lines are pairs; the authors found a double reversal in the case of the line 6240·8, and they have observed also the same effect in the case of the line 6103 ($m = 3$, first subordinate series). In the rubidium spectrum the following lines were found:—

First Subordinate Series.		Second Subordinate Series.	
m.		*m.*	
9	5151·5	5	5654·2
9	5088	5	5579·0
10	5076	6	5390·1
11	5023	6	5322·0
10	5015	7	5233·9
12	4982	8	5132·9
11	4963		
13	4953		
12	4926		
13	4892		

Some of these have been measured by Ramage in the flame spectrum; the line at 5165, given by Lecoq de Boisbandran and by Ramage, is a sharp line, and therefore the authors attribute it to an impurity. E. C. C. B.

749. *Transparency of Fog to Light Rays of Different Wave-length.* **A. Rudolph.** (Phys. Zeitschr. 5. pp. 36–39, Jan. 15, 1904.)—Photometric measurements made with the different kinds of lamps used in lighthouses and beacons, and with artificial fog, show that the transparency of the fog increases as the wave-length diminishes. The fog is produced by passing steam into a tube about 1 m. long, surrounded by a water-jacket. One part of the beam from the source examined is passed through the fog, while the other passes, after reflection, directly into the photometer. The density of the fog is gauged, *e.g.*, at 50, when an intensity of 50 c.p. is diminished to 1 c.p. after penetrating the fog. G. E. A.

750. *Structure of Gold-Leaf and the Absorption Spectrum of Gold.* **J. W. Mallet.** (Roy. Soc., Phil. Trans. 203. pp. 43–51, Jan. 29, 1904.)—It is first shown that the black irregular lines seen in fine gold-leaf under a microscope by transmitted light are in reality wires or threads of slightly greater thickness than the rest of the leaf. These are apparently due to the formation of microscopic troughs or furrows in the membrane or gold-beater's skin, between layers of which the gold is beaten out. Into these furrows the soft gold is driven, with the formation of corresponding rods or wires of extremely minute size. The thickness of transparent gold-leaf is shown to lie between 0·0000797 and 0·0002 mm. The absorption spectrum of gold was observed in the following cases: A colloidal solution obtained by reduction of the chloride by potassium formate, and also in the case of saphirine and ruby glasses. The observations were made photographically with a grating; no well-defined absorption was seen in the visible spectrum, but only general absorption in the middle portion, on the whole more marked towards the red end. There was also considerable absorption in the ultra-violet. In the case of the infra-red, observed with a bolometer, the ruby glass totally absorbs the light above D, and the transparency rapidly increases to that of ordinary glass at A. The saphirine or blue-green glass cuts off the light to near C and then rises rapidly to great transparency at A. The transparency continues as far as 2·5 μ. The colloidal solutions show great absorption in the visible region, though not so striking as in the case of the glasses, and at A they are as transparent as distilled water. E. C. C. B.

751. *Rays from an Auer Burner.* **R. Blondlot.** (Comptes Rendus, 136. pp. 1120–1123, May 11, 1903.)—It was found that rays which were sent out from an Auer burner and traversed a sheet of aluminium 0·1 mm. thick, when caused to pass through a bi-convex quartz lens were brought to a focus whose position was determined by the action exerted on a minute electric spark. The brightness of the spark was notably increased at this focus, and the index of refraction of the quartz for these rays was found to be 2·93. Other kinds of radiation for which the indices of quartz have values 2·62, 2·436, and 2·29 were also observed. The rays described are reflected by polished glass and diffused by ground-glass. The rays traverse most substances—thin sheets of metal, wood, Iceland spar, paraffin, &c., but are stopped by thin plates of rock salt, lead, platinum, and water. They also do not penetrate moistened paper. J. J. S.

752. *Blondlot's* N-*rays.* **R. Blondlot.** (Comptes Rendus, 136. pp. 1227–1229, May 25, 1903.)—Further observations are recorded on the radiations previously discovered by the author [see preceding Abstract]. Various sources of light and of heat, such as an annular gas-flame and a sheet of silver heated to redness by a Bunsen burner, seem to emit these rays. The phenomenon appears to be very general. The author suggests the designation *n*-rays (from the town of Nancy, where the experiments were made) for the sake of shortness. These *n*-rays contain a great variety of different radiations, some from an Auer burner with indices greater than 2, others from a Crookes tube having an index less than 1·52. Their presence is indicated not only by the action on a small electric spark, but by the effect on a minute blue gas-flame, which is caused by them to become more luminous and white. While the rays do not produce phosphorescence, they cause a notable increase of phosphorescence on a screen of sulphide of calcium which has been previously rendered phosphorescent by exposure to sunshine. Neither the production nor the cessation of this effect appears instantaneous. It is the easiest way of observing the action of the *n*-rays. The rays seem to be related to other

known radiations of great wave-length. The author suggests they are comprised in the five octaves of the series of radiations which remain unexplored between the rays discovered by Rubens and the electromagnetic undulations of very short wave-length. J. J. S.

753. *Giesel's Emanation-body.* **E. Goldstein.** (Deutsch. Phys. Gesell., Verh. 5. 22. pp. 392–403, Nov. 30, 1903.)—An account of some investigations of the emanation from the strongly radio-active substance obtained by Giesel from pitchblende. This emanation seems to be different from that given out by radium. The capillary tubes in which Ramsay kept the radium emanation became coloured, and the emanation possesses considerable penetrating power. The emanation from Giesel's preparation has but slight penetrating power. The characteristics of the emanation resemble those of the rays of the first layer of the kathode light which Goldstein has provisionally called S-rays. These rays are remarkable for their great sensitiveness towards electrostatic action, being strongly attracted by small negative charges, and strongly repelled by positive charges. J. J. S.

754. *Sensitising Animal Tissues to the Action of Light.* **G. Dreyer.** (Röntgen Ray, Archives, 8. pp. 119–120, Dec., 1903. Communication to the Danish Academy of Sciences.)—The author describes experiments which demonstrate that the presence of a minute quantity of erythrosine renders bacteria and infusoria much more sensitive to the action of the yellow-green rays. When a layer of human skin is placed between the cone of light from an arc lamp and infusoria sensitised in this way, they are killed in 22 sec., while normal infusoria require an hour's exposure. The skin of a frog, sensitised by hypodermic injection of erythrosine, becomes acutely inflamed when exposed for 8 min. to rays which have been passed through a K_2CrO_4 solution colour filter, rays which have little or no action on normal skin. The erythrosine employed appears to have no toxic effect upon either bacteria or infusoria, or on the rabbit and frog. It is suggested that the drug may prove useful therapeutically in heightening the bactericidal action of light in the treatment of disease. H. W. P. Y.

755. *Energy and Impulse of Röntgen Rays.* **P. Hertz.** (Phys. Zeitschr. 4. pp. 848–852, Dec. 1, 1903.)—The paper gives the development of a method for calculating, from general dynamical principles, the radiated energy and the impulse when an electron has its velocity suddenly changed, both velocities being in the same line. The single electron is replaced by three; the first of these moves with uniform velocity q_1 past a given point P at time t_0. The second "begins to exist" at P at time t_0 and moves with the same velocity q_1 but with a charge of opposite sign to that of electron No. 1. The third electron begins to exist at the point P at time t_0 and moves with velocity q_2 along the given path. Employing this artifice, a law of exchange of velocities is found, by means of which the energy and impulse are calculated. Special cases are then considered. The formulæ developed may also be obtained by calculation of the field strengths and integration over the wave-zone. The abbreviated proofs indicated will be given with fuller detail in a later paper. G. E. A.

756. *Rare Earth Oxides and Radio-activity.* **C. Baskerville** and **G. F. Kunz.** (Amer. Journ. Sci. 17. pp. 79–80, Jan., 1904.)—Various oxides of rare earths in powdered condition were mixed with radium-barium chloride of

240 activity, and the mixture was shaken in test-tubes and observed in the dark. No luminosity was noticed. Pulverised chlorophane, willemite, zinc oxide (French process), zinc sulphide, and kunzite when mixed with radium-barium chloride and carbonate gave good luminosity. It is suggested that there may be in willemite and other minerals, and in certain oxides, a new substance which acts as a radium-foil as it were. J. J. S.

757. *Radio-activity of the Atmosphere and of the Soil.* **J. Elster** and **H. Geitel.** (Archives des Sciences, 17. pp. 5–22, Jan., 1904.)—A *résumé* of the series of experiments carried out by the authors on the radio-active properties manifested by air taken from cellars or caves, and also by certain kinds of earth containing clay. As the result of experiment it appears that the radio-activity exhibited by spring water is gained by it from air which has come through the pores of the soil, or else it gains the emanation which it contains directly from a radio-active body disseminated through the earth. Thus the existence of a body possessing primary radio-active properties and disseminated through the earth, seems probable. Soils containing clay were found to be alone endowed with radio-active properties, and on treating chemically a special volcanic earth named Fango, a product more radio-active than the salts of uranium was obtained. On examining the rate of decay of the activity induced by this substance in other bodies, it was found that this coincided with the rate of decay determined for the induced radio-activity of radium. The conclusion reached is: That it is probable that minute traces of radium, occurring everywhere, are the source of the radio-activity found in air enclosed in the pores of the ground, and also of the radio-activity of atmospheric air. The general occurrence of radium would account for the widespread action of its rays. J. J. S.

758. *Physiological Radiations.* **A. Charpentier.** (Comptes Rendus, 138. pp. 45–46, Jan. 4, 1904.)—The radiations of physiological origin [see Abstracts Nos. 552 and 554 (1904)] seem to be more complex than the *n*-rays of Blondlot, hitherto described. The rays which originate from nerves, *e.g.*, a part of the brain, are largely stopped by a sheet of aluminium 0·5 mm. thick. On the other hand, rays emitted by the heart, the diaphragm, and by different muscles, are scarcely affected by such a sheet of aluminium. There appears to be a distinct radiation proper to muscle. Under slight compression the radiation from a nerve notably increases, whilst that given out by muscle is much less modified by compression. Moreover, radiation from nerve produces a distinctly greater effect than that from other tissues, upon phosphorescent sulphide heated to 40° or 50°. Nervous radiation appears to differ from pure Blondlot rays more than radiation from other parts of the body does. J. J. S.

759. *Transmission of Physiological Radiations through Wires.* **A. Charpentier.** (Comptes Rendus, 138. pp. 194–196, Jan. 25, 1904.)—The radiations sent out by the human body (or the body of an animal) appear to be capable of transmission by conduction through a metal wire. When the free end of a wire is brought near to the body, the other end being coiled round a sensitive screen of phosphorescent sulphide, the screen increases in brilliance. This effect is also observed when the free end of the transmitting wire is brought close to various sources of the *n*-rays. [See also Abstracts Nos. 552, 554 (1904), and preceding Abstract.] J. J. S,

760. *Radio-activity of Radium and its Concentration.* **E. Rutherford.** (Nature, 69. p. 222, Jan. 7, 1904.)—The question whether the radio-activity of radium depended upon its concentration was tested by measuring the radio-activity of radium bromide (1) when in the solid state and (2) when diffused throughout a solution more than a thousand times the volume of the solid. It was found that in the second case no appreciable influence on the radio-activity of the compound was exerted. The radio-activity of radium over the range investigated is not affected by its own intense radiations. It is thus improbable that the energy given out by radium is due to absorption of an unknown external radiation which is similar in character to the radiations which are emitted. J. J. S.

761. *Production of* N-*rays by Sonorous Vibrations.* **J. M. de Lépinay.** (Comptes Rendus, 138. pp. 77–79, Jan. 11, 1904.)—Increased illumination of a sulphide of calcium screen was observed when vibrations were produced in its neighbourhood by means of a tuning-fork, a bronze bell, and especially by a large steel cylinder made to vibrate transversely by blows from a hammer. The decrease in luminescence on cessation of the vibrations was specially noticeable. Compression of a solid has previously been found to produce *n*-rays, but experiments show that the effects can be got when a musical note is produced by the vibration of air alone. This is chiefly shown by the changes in illumination of the phosphorescent calcium sulphide when held above a siren giving out a note. Here the air only is the vibrating body, and when the revolving disc of the instrument was itself feebly lit up so as just to be visible, on the blast of air causing a musical note to be given out, the disc and the surrounding parts of the instrument became more clearly visible. Care was taken to avoid any mere reflex effect by stopping the ears with cotton-wool and having the operations performed by an assistant. J. J. S.

762. *Emission of* N-*rays by Vegetables.* **E. Meyer.** (Comptes Rendus, 138. pp. 101–102, Jan. 11, 1904.)—The approach of plants to a screen which was feebly fluorescent increased the brightness. The effect of the approach of the stalk and leaves was greater than that of the flower. The effect produced by compression on solids and on the nerves of animals was found to occur also in vegetable tissues. The radiations traverse aluminium, but are stopped by lead; they appear to be related to the activity of vegetable protoplasm. J. J. S.

763. *Phosphorescence of Photographic Plates.* **T. A. Vaughton.** (Nature, 69. p. 250, Jan. 14, 1904.)—A note on phosphorescent effects observed with photographic plates. A bromide photographic plate, without having been exposed, was placed in ordinary pyro-soda developing solution and allowed to remain in it for ten minutes. On taking it out and, in total darkness, plunging it into a saturated solution of aluminium sulphate, the plate immediately became phosphorescent, and the solution also luminous. The light gradually weakens, but persists for several minutes. The solution when poured off into a bottle, retains its phosphorescent property for a short time. [See also Abstracts Nos. 801 and 806 (1904).] J. J. S.

764. *Dispersion and Wave-length of* N-*rays.* **R. Blondlot.** (Comptes Rendus, 138. pp. 125–129, Jan. 18, 1904.)—Methods similar to those employed

for light were used to study the dispersion and wave-length of *n*-rays. The rays were produced by a Nernst lamp shut up in a sheet-iron enclosure pierced by a window closed by a sheet of aluminium. The rays were filtered through a pine board, 2 cm. thick, and a second sheet of aluminium as well as two sheets of black paper to eliminate all radiation foreign to the *n*-rays. In front of these screens, 14 cm. from the filament of the lamp and exactly opposite to it, is arranged a screen of moistened cardboard, in which there is a slit 5 mm. wide and 3·5 cm. high. Thus a well-defined bundle of *n*-rays is obtained. This bundle is received on a prism of aluminium, of refracting angle 27° 15′, with one of its faces normal to the incident beam. From the other face of the prism there issues a series of bundles of rays, dispersed horizontally. This is shown by the following arrangement: A slit 1 mm. wide and 1 cm. high in a sheet of cardboard is filled up with phosphorescent sulphide of calcium, and on displacing this slit, the position of the dispersed rays is determined, and their deviations being known, their indices are deduced. Radiations, the indices of which are respectively 1·04, 1·19, 1·29, 1·36, 1·40, 1·48, 1·68, 1·85, were thus shown to exist. Using an aluminium prism of 60° angle, the two first indices were separately measured and found to be 1·04 and 1·15. The indices were also measured by forming the image of the lamp filament by means of an aluminium lens, and finding by the help of the phosphorescent sulphide the position of the conjugate images of the filament. The numbers thus found did not differ much from those previously measured. By means of gratings, with rulings of 200, 100, and 50 lines per mm., diffraction fringes were formed, similar to those obtained with light, and from measurements of these the following were found to be the probable values of the wave-lengths :—

Indices.	Wave-lengths.	Indices.	Wave-lengths.
	μ.		μ.
1·04	0·00813	1·68	0·0146
1·19	0·0093	1·85	0·0176
1·4	0·0117		

A control experiment, depending on the method of Newton's rings, gave for rays of index 1·04 the wave-length 0·0085μ instead of 0·00813μ above, and for index 1·85 the value 0·017μ instead of 0·0176. The author considers his results are correct to about 4 per cent. The wave-lengths of *n*-rays are thus much smaller than those of light. This was previously indicated from the observed fact that unpolished mica and rock salt cause diffusion of the rays, whilst when these substances are polished, they are transparent to the *n*-rays.

J. J. S.

765. *Spontaneous Emission of Light by Uranium Salts.* **H. Becquerel.** (Comptes Rendus, 138. pp. 184–187, Jan. 25, 1904.)—The author calls attention to his observation that certain salts of uranium emit light continuously and with an intensity which could not be expected from their feeble radio-activity. The salt in which this emission of light is most intense is the double sulphate of uranyl and potassium, but other salts of uranium also exhibit the property. To observe the slight glimmer, which is all that can be seen in most cases, the observer's eye should be rested for a long time in the dark. The emission of light is spontaneous and continuous, exhibiting all the characteristics of an effect produced by the radio-activity of uranium. A specimen of the double salt referred to which had been kept shut up for eight years and screened from all

luminous excitation, exhibited the property as distinctly as specimens recently exposed to light. The spontaneous luminosity is permanent and seems due to the phosphorescence excited in the salt itself by the radiation which the uranium molecule sends out. An approximate photometric estimation showed that the intensity of the glimmer emitted by the double salt was about twenty thousand times more feeble than that of the light emitted from a preparation of chloride of radium whose activity was a million times greater than the activity of the uranium salt. The order of magnitude of the luminous effects is thus not the same as that of the effect on the ionisation of air.
J. J. S.

766. *Source of the Energy of Radium Compounds.* **W. Ackroyd.** (Nature, 69. p. 295, Jan. 28, 1904.)—Referring to the note by Rutherford on the behaviour of radium bromide in solution [see Abstract No. 760 (1904)], the author contends that the mere act of dilution of a milligramme of radium salt will not affect its constancy of absorption and therefore also will not materially influence its radio-activity. When a coloured solid is dissolved, the amount of absorption of light effected by the solid is equal to the amount of light absorbed by its solution, provided that the light passes through the same mass of the solid in each case. The absorption of Röntgen rays follows the same general laws as the absorption of light.
J. J. S.

767. *Radium and γ-Rays.* **J. R. Ashworth.** (Nature, 69. p. 295, Jan. 28, 1904.)—Commenting on Becquerel rays, Stokes likened the discharge of kathode rays to the discharge of a gun, the impact of kathode projectiles on a target creating an ethereal disturbance recognised as Röntgen rays. He supposed that in the same way as there is an explosive disturbance in the gun where the bullets issue, so there must be a violent ethereal disturbance where the kathode rays issue as well as where they strike. It is here suggested that it is this disturbance when the β-rays issue from radium which is detected in γ-rays.
J. J. S.

768. *Researches Relating to Radium.* **F. Soddy.** (Nature, 69. pp. 297–299, Jan. 28, 1904.)—A summary of some of the results of recent researches on radio-activity. The need for further investigation to explain the discrepancy between the atomic weight for radium as experimentally determined by Mme. Curie, viz., 225, and the number 257–8 obtained indirectly by Runge and Precht from spectroscopic data, is mentioned. The disintegration theory put forward by Rutherford and Soddy, after their experiments upon thorium, co-ordinates harmoniously the numerous unrelated and unexplained experimental facts which have accumulated during the seven years since the first discovery of radio-activity by Becquerel.
J. J. S.

769. *High-Pressure and the Radio-activity of Radium.* **W. E. Wilson.** (Roy. Dublin Soc., Proc. 10. 20. pp. 193–194, March 9, 1904.)—The author points out that if radio-activity is due to chemical changes in the radium it is probable that high pressure might reduce the rate of change taking place, since such pressure is known to modify and even arrest changes of the nature of dissociation. Rutherford estimates the life of radium as about one million years, but pitchblende containing radium is found in rocks much older than this. To investigate whether the hypothesis that the pitchblende when under the pressure of the superincumbent rock was not radio-active and only

became so after being quarried and thus relieved of the pressure, is based on fact, a small brass cell was made to hold 5 mgm. of radium bromide imbedded in Canada Balsam, together with a piece of paper coated with barium platinocyanide, the cell then being covered on both sides with mica. The whole was then fixed inside a strong window of quartz through which the screen could be observed phosphorescing brightly. The pressure was several times suddenly raised (by hydraulic pump) to 300 atmospheres without the least diminution in brightness of the screen. The pressure is taken as equivalent to that due to 3,600 ft. of rock, probably greater than pitchblende had ever been subjected to. From this experiment it is concluded that the radium had been giving off its energy for untold ages. L. H. W.

770. *Action of Radiations from Radium Bromide on some Organisms.* **H. H. Dixon** and **J. T. Wigham.** (Roy. Dublin Soc., Proc. 10. 19. pp. 178–187, March 12, 1904.)—The authors have already published results of the effects of the radiations from radium on some plants and bacilli [see Abstract No. 787 (1904)]. The experiments are now more fully described. Seedlings of *lepidium sativum* and four different bacteria were experimented with. It was found that a film of agar stopped the inhibitory radiation. The arrest of growth also takes place in cultures exposed anaerobically, so that it is neither due to ionisation of the air nor to the production of ozone by the radium. The α-rays would be stopped by the glass tube, whilst any phosphorescence of the radium itself was screened off by means of platinum-foil 0·04 mm. thick; consequently it was due to the β- and γ-rays. As the action ceased beyond 30 mm. away, the γ-rays could not have produced the effect, so that it should be due to the β-rays. Considering these as electric charges of negative signs moving with enormous velocity, it was considered possible that they might attach themselves to the H' ions of the water in the bacteria, setting OH' ions free and rendering the water in the protoplasm alkaline. Using various indicators, of which only phenolpthaleine proved suitable, such an alkalinity was noticed after exposure for one or two days, but in an appendix, added while the paper was going to press, it is stated that the authors have found the alkaline (pink) reaction of the indicator was produced also when the test object was not exposed to radium, at least under the conditions of the experiment. The detections of the electrons by this means is therefore very uncertain. Reproductions of photographs of the cultures are given. [See also Abstracts Nos. 102 and 556 (1904).] L. H. W.

REFERENCES.

771. *Relation between the Double Bond and Absorption in the Ultra-violet.* **R. Magini.** (Accad. Lincei, Atti, 12. pp. 356–362, Nov. 8, 1903.)—An examination of the known data for the absorption of the ultra-violet rays by organic compounds shows that the absorption is well marked for all compounds that possess a double bond; hence the author was led to conclude that the double linkage is the determining cause of the absorption. This view is well borne out by the further test instances given in the present paper. D. H. J.

772. *Interference Phenomena at Plane-parallel Plates.* **M. Laue.** (Ann. d. Physik, 13. 1. pp. 163–181, Dec., 1903. Abstract of Berlin Dissertation.)—The phenomena are discussed mathematically, the Airy-Lummer formula for intensity being critically examined. W. S.

773. *Double Anastigmat for Reproductions.* **W. Zschokke.** (Zeitschr. Instrumentenk., Beib. 23. pp. 229–231, Dec. 1, and 24. pp. 239–241, Dec. 15, 1903. Communication from Optischen Anstalt C. P. Goerz-Friedenau. Extract from the Photogr. Korr. 1903.)—A description of a double anastigmatic objective of long focus, composed of four lenses with one air-space. Data are supplied regarding the glasses employed and the curvature and optical properties of the lenses. G. E. A.

774. *Projection of Imitation Spinthariscope Appearance.* **O. Lodge.** (Nature, 69. p. 247, Jan. 14, 1904.)—The appearance of a zinc sulphide screen bombarded by radium can be imitated and exhibited to an audience by using two punctured kinematograph films, these being made to slide over one another slowly, either by hand or by mounting them on eccentrics, so that they move over each other in a periodic fashion. J. J. S.

775. *Fixing Photographic Plates in Daylight.* **A. W. McCurdy.** (Frank. Inst., Journ. 157. pp. 53–54; Discussion, pp. 54–55, Jan., 1904.)—A photographic plate which has been exposed and developed in the usual way may, after the developer has been thoroughly washed off, be fixed in daylight, without fogging, in 10 to 15 min. Thus by using a developing machine along with the above method, the amateur may develop plates and films without using a dark room. In the *discussion*, **N. C. Wanner** described confirmatory experiments. [See also Abstract No. 274 (1904).] G. E. A.

776. *Formation of Bubbles, Lattice-forms, and Mother-of-Pearl Colours by Illuminating Bichromated Gelatine, Silicic Acid, Albumin, &c.* **G. Quincke.** (Ann. d. Physik, 13. 1. pp. 65–99, Dec., 1903; 13. 2. pp. 217–238, Jan., 1904.)—Evidence is given of the formation initially of liquid precipitates on exposing bichromated gelatine to light and in a number of similar cases. [Compare Abstract No. 2101 (1902).] T. M. L.

777. *Chronophotography of Rapid Movements.* **L. Bull.** (Comptes Rendus, 138. pp. 755–757, March 21, 1904.)—The author describes an experimental arrangement for photographing very rapidly moving objects by means of electric sparks. These latter are produced by a small coil and Leyden jar between magnesium electrodes placed in the focus of a lens, on the far side of which is a camera. This is provided with a rotating contact-breaker in the primary circuit of the coil. Inside the camera a cylinder, covered on the periphery with sensitised film, is caused to revolve rapidly, and, by means of a projection on the edge of the cylinder, a shutter is opened and automatically closed after one complete revolution. The author has thus obtained exposures at the rate of 1,500 images per sec. L. H. W.

778. *Relations between Ordinary and Magnetic Rotation of the Plane of Polarisation of Light.* **J. Disch.** (Ann. d. Physik, 12. 5. pp. 1153–1157, Nov., 1903. Extract from the Inaugural Dissertation, Freiburg, 1903.)—By polarimetric measurements, first in a non-magnetic then in a magnetic field, the author confirmed G. Wiedemann's rule, viz., that the magnetic rotation of the plane of polarisation of light is proportional to the already existing natural rotation; he experimented with German, French, and American turpentine, oil of lemons, paraffin, ethyl valerianate, diethyl tartrate, and quartz. D. H. J.

779. *Action of Ultra-violet Light on Moist Air.* **J. H. Vincent.** (Cambridge Phil. Soc., Proc. 12. pp. 305–311, Jan., 1904.)—Notes on experiments made on the behaviour of the remarkable cloud formed in moist air by ultra-violet light. The effect appears to be of a twofold character. Some unidentified substance is formed which is less volatile than water, and a solution of which in water forms the droplets. The air is ionised, and the ions get on the cloud-drops, just as ions produced by any other process would be caught by any finely divided substance floating in the air. J. J. S.

780. *Polarisation of Light Diffused by Refraction.* **A. Lafay.** (Comptes Rendus, 136. pp. 1251–1254, May 25, 1903.)—Results very similar to those obtained in the previous work [see Abstract No. 991 (1899)] on light diffused by reflection are here presented. The existence of focal directions is shown, as in the case of reflection; but certain important differences are pointed out. J. W. P.

781. *Separation of Spectral Rays very close to one another.* **A. Perot** and **C. Fabry.** (Journ. de Physique, 3. pp. 28–32, Jan., 1904.)—The authors, in discussing the results obtained by Lummer and Gehrcke [see Abstract No. 1362 (1903)], point out that these are quite different to those obtained by other observers. For instance, the red ray of cadmium has been found by various observers to be simple, in contradiction to Lummer and Gehrcke. This variation of results is not to be ascribed to a superiority of the apparatus of the latter observers, but is more probably due to false images or ghosts. G. E. A.

782. *Scintillations Caused by Radio-active Substances in Sidot-Blende.* **J. Elster** and **H. Geitel.** (Phys. Zeitschr. 4. pp. 439–440, May 1, 1903.)—Description of the scintillating phosphorescence obtained with a Sidot-blende screen, which was produced on exposing it to the radio-active emanation contained in air taken from places close to the earth's surface. This was observed by the authors before seeing the account of Crookes' experiments with particles of radium salts. J. J. S.

783. *Radio-active Emanation in Atmospheric Air.* **J. Elster** and **H. Geitel.** (Phys. Zeitschr. 4. pp. 522–530, July 1, 1903. From Report of Commission appointed by the associated Academies and learned Societies for investigating atmospheric electricity; prepared for the Munich meeting, June 5 and 6, 1903.)—The first part of the paper discusses the origin of the radio-active emanation contained in air near the surface of the earth, and describes various measurements made on the radio-activity of air taken from different situations. The conclusion reached is that the earth itself possesses radio-activity. The second part of the paper treats of the connection of the radio-activity of the free atmosphere with various meteorological elements, such as the potential of the air, the dissipation of electricity, the occurrence of mist, the direction of the wind, and height of the barometer. [See also Abstracts Nos. 638 and 738 (1903).] J. J. S.

784. *Radio-activity of Ordinary Materials.* **E. Rutherford.** (Nature, 67. pp. 511–512, April 2, 1903.)—A short note referring to the radio-activity observed in the case of substances ordinarily met with. J. J. S.

785. *Radio-activity.* **E. A. Partridge** and **R. H. Bradbury.** (Frank. Inst., Journ. 156. pp. 321–334, Nov., 1903.)—An historical account of the discovery of radio-active substances, their behaviour, and some of the theories put forth to explain it. J. J. S.

786. *Radio-active Substances.* **Mme. S. Curie.** (Annal. Chim. Phys. 30. pp. 289–326, Nov., 1903.)—A *résumé* of recent researches on the behaviour of radio-active bodies, with special reference to the work carried out by Madame Curie in collaboration with P. Curie. Madame Curie gives in conclusion a statement of her own personal share in these researches. J. J. S.

787. *Action of Radium on Bacteria.* **H. H. Dixon** and **J. T. Wigham.** (Nature, 69. p. 81, Nov. 26, 1903.)—Five mgm. of radium bromide placed 5 mm. from an agar culture has an inhibitory action on the growth of Bacillus typhosus, B. anthracis, &c., in the culture, but does not entirely destroy them. [See also Abstract No. 770 (1904).] P. E. S.

788. *Heating Effect of the Radium Emanation.* **E. Rutherford** and **H. T. Barnes.** (Nature, 69. p. 126, Dec. 10, 1903.)—The authors, in answer to A. Schuster [see Abstract No. 101 (1904)], point out that they distinguish clearly between the primary and the secondary heating effects of radium emanations. D. H. J.

789. *Bactericidal Action of Radium Rays.* **Pfeiffer** and **Friedberger.** (Berlin Klin. Wochenschrift, July 13, 1903. Abstract in Archives d'Él. Médicale, 11. pp. 751–752, Dec. 15, 1903.)

790. *Bactericidal Action of Radium Rays.* **Hoffmann.** (Hygienische Rundschau, 13. 18. 1903. Abstract in Archives d'Él. Médicale, 11. pp. 752–753, Dec. 15, 1903.)

791. *Examination of the Gas Occluded or Set Free by Radium Bromide.* **Dewar** and **Curie.** (Comptes Rendus, 138. pp. 190–192, Jan. 25, 1904.)—A spectroscopic examination of the gas pumped off from radium bromide showed that it contained helium. E. C. C. B.

792. *Radio-active Processes.* **E. Rutherford.** (Phys. Soc., Proc. 18. pp. 595–597; Discussion, pp. 598–600, Dec., 1903.)—Abstract of a paper in which the author gave a summary of his researches on thorium and radium, followed by an abstract of the discussion upon the paper at a meeting of the Physical Society on June 5, 1903. J. J. S.

793. *Secondary Radiation Produced by Radium Rays.* **L. R. Wilberforce.** (Nature, 69. p. 198, Dec. 31, 1903.)—In a radiograph obtained by placing two partially overlapping pennies contained in a paper envelope upon a photographic plate, the shadow of the upper coin was found to be blurred and diminished where the rays passed through air from the edge of this coin to the plate, but it was sharp and of the correct size where the rays passed to the plate through the lower coin. This seems to point to the production of a considerable secondary radiation by the rays in their passage through air. J. J. S.

794. *Action of Radium Rays on Mercurous Salts.* **S. Skinner.** (Cambridge Phil. Soc., Proc. 12. pp. 260–261, Jan., 1904.)—The mercurous sulphate employed in Clark cells darkens on exposure to light. It was found that it was the violet and ultraviolet rays which produced the effect. The action of the rays from radium bromide was similar to that of light rays. When the salt was exposed to the radiation from 10 mgm. of radium bromide, a visible result was observed in twenty-four hours, and a very marked darkening occurred in three or four days. It is probable either that a dark sub-salt is formed or that a polymeric modification is produced. J. J. S.

795. *Radium.* **W. Ramsay.** (Scientific American, 90. p. 9, Jan. 2, 1904.)—Notes on recent researches on radium reprinted from the London *Daily Mail.* J. J. S.

796. *Radio-activity.* **A. Despaux.** (Revue Scientif. 1. pp. 7–12, Jan. 2, 1904.)—Theoretical speculations on the source of energy in radio-activity. Analogies between planetary orbits and revolutions and molecular and atomic movements are considered. The possibility of a similarity between the store of energy which may exist in a permanent magnet and that which comes into action in the phenomena of radio-activity is also dealt with. J. J. S.

797. *Behaviour of Blende.* **E. P. Perman.** (Chem. News, 89. p. 33, Jan. 15, 1904.)—Note on the observation of apparently spontaneous scintillations in a blende screen without the intervention of radium. J. J. S.

798. *Radium in Bath Springs.* **R. J. Strutt.** (Nature, 69. p. 230, Jan. 7, 1904.)—The deposit obtained from the new Royal Spring at Bath has been found to contain radium in appreciable quantities. The gas which bubbles up from the springs contains a small proportion of helium, which probably owes its origin to large quantities of radium at a great depth below the earth's surface. J. J. S.

799. *Radio-active Gas in Mineral Springs.* **Blythswood** and **H. S. Allen.** (Nature, 69. p. 247, Jan. 14, 1904.)—A letter stating that conclusive evidence of the presence of radium emanation in the Buxton springs has been obtained. The activity of the gas obtained falls to half value in about 3½ days; this corresponds with the time for the radium emanation. J. J. S.

800. *Radium.* **J. Danne.** (Génie Civil, 44. pp. 161–165, Jan. 16; 183–187, Jan. 23, and pp. 199–202, Jan. 30, 1904.)—An historical summary of the researches dealing with radium, giving an account of the method of extraction from pitchblende, the apparatus used in the investigation of its properties, and the hypotheses brought forward to explain the facts observed. J. J. S.

801. *Phosphorescence of Photographic Plates.* **H. J. Edwards.** (Nature, 69. p. 272, Jan. 21, 1904.)—A note on the occurrence of phosphorescence in photographic plates and developers with various solutions. [See Abstracts Nos. 763 and 806 (1904).] J. J. S.

802. *Blondlot's* N*-ray Experiments.* **A. A. C. Swinton.** (Nature, 69. p. 272, Jan. 21, 1904.)—A note suggesting that Blondlot's observations must be due not to physical but to physiological processes, and that these are not operative in the case of all persons, the author having repeated most of the experiments without discerning the slightest trace of any of the phenomena described by Blondlot. J. J. S.

803. *Radio-activity and Radiation.* **L. Bell.** (Elect. World and Engineer, 43. pp. 168–169, Jan. 23, 1904.)—A general discussion of recent work on the subject.

804. *Radium.* **P. Curie.** (Électricien, 27. pp. 49–62, Jan. 23, 1904. Conférence à l'Ecole Professionnelle Supérieure des Postes et des Télégraphes, Jan. 13, 1904.)—A *résumé* of the researches on radio-activity recently carried out by the author and by others. J. J. S.

805. *Blondlot's* N*-rays.* **S. G. Brown.** (Nature, 69. p. 296, Jan. 28, 1904.)—The writer of this note observed that a feebly luminous phosphorescent zinc sulphide screen increased in brightness when brought near the body. Further observations have led him to the conclusion that the effect is due to heat. On holding the screen with its back against a fluted jar containing warm water, the zinc sulphide brightens up along the edges of the fluting and indicates the pattern, which appears as dark lines on a lighter background on removing the screen. J. J. S.

806. *Phosphorescence.* **O. F. Bloch.** (Nature, 69. p. 296, Jan. 28, 1904.)—On accidentally mixing some spent pyro developer and a dilute solution of alum, the whole liquid glowed with a brilliant phosphorescence. This occurs whenever a dilute aqueous solution containing pyro, a soluble sulphite, and an excess of alkali is made acid. [See Abstracts Nos. 763 and 801 (1904.) J. J. S.

807. *Radio-activity.* **J. Gray.** (Elect. Rev. 54. pp. 194–196, Jan. 29, 1904.)—This is an abstract of a lecture delivered before the Aberdeen Society of Mechanical Engineers. J. J. S.

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808. *Calorimetry with Platinum Thermometers.* **W. Jaeger and H. v. Steinwehr.** (Deutsch. Phys. Gesell., Verh. 5. 20. pp. 353–362, Oct. 30, 1903. Communication from the Physikalisch-Technische Reichsanstalt.)—The water value of a Berthelot calorimeter was previously measured using mercury thermometers [see Abstract No. 1217 (1903)], and the present paper gives an account of its remeasurement with a platinum resistance thermometer. The accuracy obtained was ten times greater than in the former experiments, although the temperature interval employed was little more than half the interval employed in the former experiments. J. B. H.

809. *Electrical Method of Determining Latent Heats of Vaporisation.* **A. C. Smith.** (Roy. Soc. Edinburgh, Proc. 24. pp. 450–459, 1902–1903.)—A glass calorimeter is suspended by a platinum wire from one arm of a balance: through its base pass two copper electrodes ¼ in. diam., whose upper ends are joined by four platinum wires in parallel, each 0·037 cm. thick and 5·6 cm. long, and whose lower ends dip into mercury cups when the beam of the balance rests on its supports, though swinging free when the beam is raised for a weighing. The calorimeter is shielded from the outside by an inner vessel of light tinned iron and an outer wooden case, which are furnished with apertures for the free passage of the suspending wire and the thick copper leads which join the mercury cups to storage batteries (a current of about 50 amperes being needed). The calorimeter is thus jacketed by the vapour of the liquid under experiment, but to ensure that the radiation-correction may be negligible, a further supply of the same vapour at the same pressure is passed into the outer case. An experiment is made by weighing the calorimeter and its contents when they are at the boiling-point, passing a current through it for a known time, and then by another weighing determining the mass of liquid vapourised. Hitherto only preliminary experiments with water have been made. R. E. B.

810. *A Method of Ice-Calorimetry.* **H. E. Schmitz.** (Manchester Lit. and Phil. Soc., Mem. 48. 3. pp. 1–20, Dec., 1903.)—Weigh a cylinder with rounded ends; immerse it in liquid air; leave it till its temperature is that of the liquid, and then remove it to a vessel containing ice-cold water. After sufficient time, remove it to a balance and weigh. The gain in weight is due to the ice formed on its surface. Care must be taken to exclude bubbles and water from the weighing and to remove liquid air from the cylinder before it is placed in the water. By this means the specific heats of various materials are found from 185° to 0° C. A summary of this method is given in Proc. Roy. Soc., vol. 72. pp. 187–190, 1903. P. E. S.

811. *Thermal Expansion of Quartz and other Substances.* **K. Scheel.** (Phys. Tech. Reichsanstalt, Wiss. Abh. 4. pp. 35–60, 1904.)—The interference method of Fizeau is employed, and the temperatures range from that of the room to 100°. The work is in two sections: (1) The absolute determination for quartz (in the direction of the principal axis); (2) the relative determinations for platinum, palladium, amorphous quartz, Berlin porcelain, and Jena borosilicate glass. The interference apparatus, by Zeiss, of Jena, is fully described. For quartz the expansion is given by—

$$l_t = t_0(1 + 7{\cdot}144 \times 10^{-6}t + 0{\cdot}00815 \times 10^{-6}t^2).$$

Comparison with results by Fizeau, Benoit, and Reimerdes is given. J. W. P.

812. *Pressure Determination with a Closed Air Manometer.* **C. H. Brinkman.** (Konink. Akad. Wetensch. Amsterdam, Versl. 12. pp. 510–518, Feb. 25, 1904. Translated from Versl. van de gewone vergadering der Wis- en Natuurkundige Afdeeling, Jan. 30, 1904.)—Measurements of air pressures may be made with closed air manometers by the use of the isotherms determined by Amagat for pressures ranging between 100 and 3,000 atmospheres. For pressures smaller than 100 atmospheres it is necessary to extrapolate. The author has, in doing this, availed himself of van der Waals well-known equation, and has been able to obtain a reliable expression containing five constants. These are calculated for 15°·7 C. As it may be advisable to keep the manometer in a water bath, the temperature of which is kept constant by a thermo-regulator at about 20° or 25°, it is of importance to ascertain whether the same constants can be used at these higher temperatures, and he finds that this can be assumed to the same degree of accuracy. Tables are given of the values of the pressure for different volumes in the case of the above three mentioned temperatures. W. W. H. G.

813. *Chemical Reactions at very High Temperatures.* **C. Zenghelis.** (Zeitschr. Phys. Chem. 46. pp. 287–292, 1903. Chemisches Laboratorium der technischen Hochschule, Athens.)—Theoretically a temperature of 10,000° C. should be obtainable by the combustion of pure carbon in oxygen; practically the highest temperature so obtained is 2,500° C., one of the chief causes of the loss of heat being the dissociation of the products of combustion. In the case of the combustion of aluminium in oxygen, the product of combustion is solid and there is no dissociation, and the reaction can be confined to a small space; consequently the temperature reached should be very high. The theoretical temperature is 19,800° C., so that a temperature of at least 10,000° C. ought to be reached, since it has been shown that the actual temperature produced in the Goldschmidt method for the reduction of metallic oxides is about half the theoretical. The author burns previously heated aluminium in pure oxygen and finds that alumina, platinum, lime, and magnesia are volatile at the temperature produced. If, during the reaction, the oxygen is replaced by nitrogen, aluminium nitride is formed, the temperature falling at the same time, because of the endothermic reaction. Aluminium nitride is always formed during the cooling of the crucible, being formed from the unburnt aluminium. Aluminium, at this temperature, combines with superheated steam with explosive violence. In nitrous oxide, aluminium burns with the formation of nitride and a little oxide; a similar reaction takes place in nitric oxide, but is more intense. Strongly heated aluminium also burns in carbon monoxide; no trace of carbon is left, but a little carbide is formed. The carbide reacts with water with the formation of methane. At this high temperature some of the oxygen is transformed into ozone. The author claims to have produced the highest temperatures so far obtained by purely chemical means; they are at least as high, if not higher, than those obtained with an electric furnace. T. S. P.

814. *Fractional Combustion of Gaseous Mixtures containing Hydrogen by Heated Palladium Wire.* **F. Richardt.** (Zeitschr. Anorg. Chem. 38. 1. pp. 65–91, Jan. 2, 1904. Chem.-techn. Institut der techn. Hochschule, Karlsruhe.)—The author's experiments on the combustion of gases were made by passing the gases through a glass spiral containing a palladium wire and heated to various temperatures. Below 450° methane does not burn, but above 450° and below a visible red heat, appreciable proportions of this gas burn if left in contact with the palladium a sufficiently long time; with shorter times of contact, 600–650° is not a high enough temperature to cause noteworthy combustion. At both the above-named temperatures hydrogen burns completely, whatever the time of contact. If a mixture of hydrogen and methane be passed slowly over the palladium at a temperature not greater than 450°, the latter gas will not be burnt; but with rapid flow, the combustion of the hydrogen causes rise of temperature, and the methane is burnt. The separation of mixed ethane and methane cannot be effected by the method of partial combustion. T. H. P.

815. *The Water-gas Equilibrium in the Bunsen Flame and the Chemical Determination of Flame Temperatures.* **F. Haber** and **F. Richardt.** (Zeitschr. Anorg. Chem. 38. 1. pp. 5–64, Jan. 2, 1904. Chem.-techn. Institut der technischen Hochschule, Karlsruhe.)—This exceedingly important paper contains a discussion of the older investigations of the reactions in the Bunsen flame; separation of cones; investigations of the water-gas equilibrium and experiments on the composition of the gas on leaving the inner zone, as applied to the determination of the temperature of the flame. Reference is also made to the action of the Auer incandescent mantle. The chief results obtained by the authors are: The water-gas equilibrium is established in the inner green cone with very great velocity, and the constant which was found agreed very well with that calculated from Hahn's results. After passing from the zone of combustion, and while passing through the intermediate space (between the separated flames), this equilibrium is not appreciably altered. The temperature of the flames was determined by analysis of the gas mixture passing from the inner flame and by application of the alteration in the value of the equilibrium constant of the water-gas equilibrium with the temperature. This method was applied to flames of coal-gas and of coal-gas and carbon dioxide in the temperature range of 1,275° to 1,500°. The values found agreed very well with those obtained by thermoelectric measurements, and also by calculation of the heats of combustion and specific heats of the participating gases. The luminosity of the inner cone is not considered to be due to the high temperature, but the authors consider that the formation of water-gas in the inner zone gives out a greater portion of the liberated energy in the form of short wave radiation than is due to temperature alone. The phenomenon is therefore due to luminescence. The authors further consider that the Auer mantle does not act (or not mainly) by bringing about a rise of temperature owing to catalytic acceleration of combustion. A. F.

816. *Relation between Molecular Heat of Solidification and Boiling-point.* **de Forcrand.** (Annal. Chim. Phys. 28. pp. 384–422, March, and pp. 531–574, April, 1903.)—The author gives the results of a series of previously published researches [see Abstracts Nos. 1497, 2419, 2420 (1901) and 1858 (1902)] on the relation between the molecular heat of solidification and the boiling-point, expressed by the equation $(L + S)/T = Q/T' = K = 30$, where L is the latent heat of evaporation, S the latent heat of solidification, Q the latent heat of dissociation, and T and T′ respectively the absolute temperatures at which the vapour pressures in dissociation and evaporation are equal to the atmospheric pressure. Since the heat of combination, Q, of a gas with a solid body to form another solid body, is made up of the three magnitudes $L + S + C$, where C is the true heat of combination, $(L + S)/T$ may be put equal to $(L + S + C)/T' = C/\theta$, where θ equals $T' - T$ and so represents the increase in the boiling-point produced by the chemical combination. If θ has a low value, L and S are practically independent of the temperature. The value of S, which is, however, relatively small, is somewhat indefinite, owing to retardation and polymerisation phenomena. In order to establish the validity of the above relation, various elementary and compound bodies have been examined. The complete data required are only available for carbon dioxide ammonia, and water. For carbon dioxide, $(L + S)/T = 32{\cdot}12$, and from the heat of formation and dissociation temperature of carbonates, it is found that Q/T' is constant and has the value about 32. For ammonia, $(L + S)/T = 31{\cdot}93$; investigation of the dissociation of a number of additive compounds of metallic chlorides and ammonia shows that $Q/T' = 32{\cdot}33$. The additive compounds of methylamine and ethylamine with lithium chloride and bromide gives values for Q/T' varying from 31 to 39; the ammonio-copper sulphates also give high ratios. For water, $(L + S)/T = 29{\cdot}73$, and for several saline hydrates Q/T' has a value slightly above 30; for these hydrates T′ has mostly been obtained by extrapolation and is hence only approximate. It is noteworthy that Q/T' usually exceeds $(L + S)/T$ by 1. The following are the values of $(L + S)/T$ in other cases: Bromine, 29·52; chlorine, 32·21; iodine, 27·80; ethylene glycol, 30·84; trimethylcarbinol, 30·85; naphthalene, 31·43; phenol, 29·48; aniline, 29·92; benzene, about 28; nitrobenzene, 28·20; ethylene bromide, 28·20; methyl oxalate, 32·27; chloral, 31·44; butyric acid, 28·84; formic acid, 29·86; and acetic acid, about 32. The value 30 for $(L + S)/T$ may be employed for determining the molecular weight from the heats of vaporisation and solidification. T. H. P.

817. *Relation between Molecular Heat of Solidification and Boiling-point.* **de Forcrand.** (Annal. Chim. Phys. 29. pp. 5–58, May, 1903.)—The author gives a *résumé* of some of the results already published [see preceding Abstract] and indicates certain consequences of the relation $(L + S)/T = 30$, which he has established. This expression may be converted into a form similar to that of the equation of condition for gases, and then leads to the deduction that the quantity of heat generated when 1 gm. of any gas solidifies can be calculated by dividing its absolute boiling-point by its theoretical density and multiplying the result by 1·039. The author shows further how deviations from the relationship, $(L + S)/T = 30$, may be accounted for by polymerisation and how the results obtained may be used for determining the degree of molecular association. In the majority of cases the sum $(L + S)$ is determined, but the separate values of these magnitudes can be arrived at. Since $(L + S) = M(l + s)$, the values of the latent heat of solidification and the boiling-point give a means for calculating the molecular weight M; the numbers thus obtained for the molecular weights of sulphur, acetic acid, &c., agree well with those obtained in other ways. The value for mercury at its boiling-point corresponds with the formula $Hg_{1{\cdot}1}$. The author calculates the heats of formation of certain compounds from their gaseous constituents, the values arrived at varying widely from those usually accepted. The composition of the hydrates of a number of gases, *e.g.*, Ar, CH_4, CO_2,

N_2O_3, &c., are also determined. The following is the general law deduced from the above investigations: In all reversible phenomena, whether physical or chemical, in which one molecule of a gas assumes the solid state, the heat disengaged is proportional to the boiling-point. T. H. P.

818. *Relation between the Melting-point of Glauber's Salt and the Pressure.* **G. Tammann.** (Zeitschr. Phys. Chem. 46. pp. 818–826, 1903. Institut für anorg. Chemie, Göttingen.)—If Glauber's salt is melted it forms a saturated solution of the anhydrous salt, and a little of the anhydrous salt separates out. Since hydrated crystals can only be obtained by adding a crystal of the hydrated salt, the system is mono-variant as regards changes of pressure. When the salt is melted below a pressure of 750 kg. per sq. cm. it expands, when melted above this pressure it diminishes; up to the present it is the only substance behaving in this way with easily attainable pressures. In these experiments the change of temperature was measured by a thermoelectric couple. By using the Clapeyron-Clausius formula the change of temperature could be calculated from the compressibility and the latent heat of fusion. The two results are compared:—

Pressure (kg. per sq. cm.).	Δt (found).	Δt (calculated).
300	+0·14	+0·09
500	+0·23	+0·10
750	+0·27	+0·08
1,000	+0·22	−0·00
1,500	−0·03	−0·30
2,000	−0·56	−0·85
2,500	−1·13	−1·53
3,000	−2·02	−2·46

From his observations the author concludes that at high pressures only the isotropic or fluid state can be stable. F. S.

819. *Sublimation Curves of Binary Mixtures.* **H. W. Bakhuis Roozeboom.** (Konink. Akad. Wetensch. Amsterdam, Versl. 12. pp. 408–410, Jan. 21, 1904. Translated from Versl. van de gewone vergadering der Wis- en Natuurkundige Afdeeling, Dec. 19, 1903.)—From the p, t, x-representation of the equilibria for solid, liquid, and gaseous phases [see Abstract No. 512 (1903)], it is possible to deduce in what manner the evaporation of the mixtures of two solid substances—or inversely, their condensation from a mixture of vapours on cooling—takes place under a constant pressure by change of temperature. To this end a t, x-section at constant pressure is made through the figure at such a height that no other equilibria occur than those between solid and vapour or solid and solid; this can be done by keeping below the pressure of the quadruple-point, where the two solids coexist with liquid and vapour. The figure obtained is analogous with that representing the solidification or fusion of binary mixtures in which only the two components occur as solid phases. The analogy also holds good for the initial parts of the sublimation curves, for the direction of which a formula is deduced, similar to that giving the lowering of the melting-point, viz., $\Delta T = 0{\cdot}02T^2/Q$, Q representing the molecular heat of evaporation of the solid substance. This formula for the lowering of the sublimation temperature of one substance by 1 mol. per cent. admixture of the other only applies,

however, in the case of exceedingly small quantities of admixture, as the supposition made—that the p, t-curve for the equilibrium of a single solid with its vapour is a straight line—is an incorrect one. T. H. P.

820. *Vapour Pressures of Concentrated Solutions of Sulphuric Acid at High Temperatures.* **B. Briggs.** (Soc. Chem. Ind., Journ. 22. pp. 1275–1277, Dec. 15, 1903.)—The author has extended the work of Regnault and Sorel on the vapour pressure of sulphuric acid solutions from 100° to 200° C. The method adopted was to aspirate a measured volume of pure dry air through the acid, and weigh the water carried over, the vapour pressure being calculated from the formula $p = 62290 \times \frac{wT}{Mv}$, where w = weight of water carried over, T = absolute temperature of acid, M = molecular weight of water, v = volume of air in c.cm. aspirated through the liquid, corrected to 0° C. and 760 mm. Acids of varying strength were examined, with the following results :—

Concentration of Acid. Per cent. H_2SO_4.	Vapour Pressure in mm. of Mercury.				
	100°.	125°.	150°.	175°.	200° C.
77·51	20·2	90·8	300·0	...	...
79·17	14·3	67·5	210·0	...	...
81·81	8·5	40·0	126·5	400	...
84·26	5·3	23·1	76·7	230	...
87·32	2·4	10·5	43·5	113	367
91·22	...	5·0	15·0	51	149

W. H. Si.

821. *Laws of Displacement of Thermodynamic Equilibrium.* **E. Ariès.** (Comptes Rendus, 136. pp. 1242–1244, May 25, 1903.)—Consider a system in equilibrium at uniform temperature T and uniform pressure p. Suppose this transferred without change of temperature or pressure from its environment to another at uniform temperature T′ and pressure p', and there assume these conditions. Its entropy, energy, and volume changing by $\phi' - \phi$, $E' - E$, $v' - v$ respectively, it will gain, and the environment will lose, heat $E' - E + p'(v' - v)$, so that as the whole change of entropy is an increase, the total action being irreversible, $\phi' - \phi - \{E' - E + p'(v' - v)\}/T' > 0$, or $H' - H - (T' - T)\partial H/\partial T - (p' - p)\partial H/\partial p < 0$, where $H \equiv E - T\phi + pv$ is the thermodynamic potential; and if the changes of temperature and pressure are small, this is equivalent to—

$$(\partial^2 H/\partial T^2)dT^2 + 2(\partial^2 H/\partial T\partial p)dTdp + (\partial^2 H/\partial p^2)dp^2 < 0,$$

which requires $\partial^2 H/\partial T^2$, $\partial^2 H/\partial p^2$, $(\partial^2 H/\partial T\partial p)^2 - (\partial^2 H/\partial T^2)(\partial^2 H/\partial p^2)$ all to be negative. From this it follows that the isopiestic and isometric specific heats must necessarily be positive, and the former the larger, and that the isothermal and isentropic compressibilities are also necessarily positive, and the former the larger. The inequality may also be written $dpdv - dTd\phi < 0$, whence (1) in a reversible isopiestic or isometric process the temperature increases or decreases according as heat is absorbed or emitted; (2) in a reversible isothermal or isentropic process the volume increases or diminishes according as the pressure falls or rises. R. E. B.

822. *Variation of Entropy.* **S. H. Burbury.** (Phil. Mag. 6. pp. 251–259, Aug., 1903.) **H. A. Bumstead.** (Phil. Mag. 7. pp. 8–14, Jan., 1904.)—Burbury takes exception to a conclusion of Willard Gibbs in his "Statistical Mechanics" that the density in phase and the entropy in ensembles of systems, though rigorously constant on the assumptions of the theory, may possibly be variable in a sufficiency of time, or—to quote an illustration of this general conclusion—that a finite amount of stirring will not affect the mean square of the density of colouring matter added to water, while an infinite amount of stirring may produce a condition in which the mean square of the density has its minimum value, and the density is uniform. He thinks that Gibbs' difficulty may be overcome by defining the density in phase and the entropy with reference to a *finite* extension in phase, in which case they will vary even in short periods. The assumptions made are, anyhow, insufficient to determine whether the energy tends in general to increase or diminish. Bumstead thinks that Gibbs really based the doctrine of the increase of entropy rather upon the finiteness of our perceptions than upon the infiniteness of time, and that, though he took the average value of a certain function of the phase for a whole ensemble to correspond with the entropy of any body represented by the ensemble, he did not identify this function for a single system of the ensemble as entropy. He then gives reasons for the conclusion that, instead of an assumption being required to make the entropy increase, an assumption would be necessary to keep it from increasing. R. E. B.

823. *On the Law of Corresponding States and the Equation of State.* **H. Happel.** (Ann. d. Physik, 13. 2. pp. 340–361, Jan. 26, 1904.)—Corresponding substances such as ether, benzene, fluorbenzene, &c., give values for the universal constant f in van der Waals' equation $-\log\frac{p}{p_k} = f\frac{T_k - T}{T}$, which, although not quite constant, are very nearly the *same* function of the reduced temperature T/T_k. If we assume that a monatomic substance such as mercury also corresponds with the above substances, two observations of co-related values of p (vapour pressure) and t will suffice to enable us to calculate P_k and T_k. Proceeding in this way, we get for mercury, $T_k = 1009$, $P_k = 59$ atm.—values which are obviously false, since Cailletet, Colardeau, and Rivière [see Abstract No. 1814 (1900)] have observed the vapour pressures and temperatures of mercury up to 1,153° (absolute) and 162 atm. By means of the above method, however, we can show that the monatomic gases, argon, krypton, xenon, correspond, although they do not correspond with ether, benzene, &c. If we make the natural assumption that mercury corresponds with these monatomic gases, then the following values can be calculated for the critical constants of mercury; $T_k = 1370$ (absolute), $p_k = 456$ atm. The paper concludes with considerations relating to the equation of state, for which reference must be made to the original. F. G. D.

REFERENCES.

824. *Heats of Formation of Barium Compounds.* **Guntz.** (Comptes Rendus, 136. pp. 1071–1072, May 4, 1903.)—The following are the heats of formation determined by the author: Barium oxide, 133·4 Cal.; barium nitride, Ba_3N_2, 149·4 Cal.; barium hydride, 37·5 Cal.; barium amide, by the reaction $Ba + 2NH_3 = Ba(NH_2)_2 + H_2$, 53·3 Cal. T. H. P.

825. *Physical Properties of Trimethylcarbinol.* **de Forcrand.** (Comptes Rendus, 136. pp. 1034–1037, May 4, 1903.)—Pure trimethylcarbinol melts at 25·45° and boils at 82·8° (corr.) under 761·4 mm. pressure. Its heat of solution in water at 16° is 3·15 Cals.; specific heat in the liquid state, 0·722 (from 25·45° to 44·80°), and in the solid state, 0·560 (from − 21·50° to + 14°); latent heat of solidification, 0·020978 Cal., and that for 1 gramme mol. (solid), 1·552 Cal. (at 25·45°); latent heat of liquefaction (liquid), 9·426 Cals. (at 82·8°). Trouton's formula hence has a value 26·49—which is very near to those found for other aliphatic alcohols—and that of the author, $(L + S)/T$, 30·85. T. H. P.

826. *Laws of Displacement of Chemical Equilibrium.* **L. Ariès.** (Comptes Rendus, 137. pp. 253–255, July 27; 738–741, Nov. 9, and pp. 1239–1242, Dec. 28, 1903.)—The author develops Gibbs' thermodynamics, presumably for his own satisfaction. It is difficult to see why these papers are published, unless the author is ignorant of the work of Gibbs, and its exposition at the hands of Duhem, Planck, Riecke, Natanson, Saurel, van Laar, and many others. F. G. D.

827. *Heat of Radium.* **E. J. Mills.** (Nature, 69, p. 224, Jan. 7, 1904.)—The author traces a connection between the phenomena exhibited by radium, and a theory of the formation of elementary bodies based on polymerisation and its reversal, published by him a number of years ago. F. G. D.

828. *Critical States of a Binary System.* **P. Saurel.** (Journ. Phys. Chem. 6. pp. 629–635, Dec., 1902.)—A mathematical discussion of theorems relating to the critical states of a two-component system, based on the conditions given by Gibbs. The theorems deduced by the author have been previously demonstrated in a different way by van der Waals (Kontinuität, vol. 2. pp. 131–146) and by Duhem (Mecanique Chimique, vol. 4, pp. 109–121). F. G. D.

829. *Deduction of the Value of the Osmotic Pressure in Dilute Solutions from the Kinetic Theory.* **P. Fireman.** (Journ. Phys. Chem. 6. pp. 636–639, Dec., 1902.)—The author concludes from simple reasoning based on a kinetic view that the molecular kinetic energy of the solute is the same as that of a gas at the same temperature, and that the number of impacts on unit area of the semipermeable wall in unit of time is dependent only on the concentration. From this it follows that the osmotic pressure of a substance in dilute solution will be equal to the corresponding gas pressure. F. G. D.

830. *Change of Volume Occurring in Phase-changes of Binary Mixtures.* **I. R. Hollmann.** (Ann. d. Physik, 13. 2. pp. 325–339, Jan., 1904.)—The author discusses both analytically and graphically by means of space-diagrams the volume-changes occurring in the melting and evaporation of binary mixtures of two components. F. G. D.

831. *Vapour Pressure and Latent Heat.* **G. Bakker.** (Zeitschr. Phys. Chem. 47. pp. 231–232, Feb., 1904.)—The law of the linear diam. does not follow, as asserted by Batschinski [see Abstract No. 451 (1903)], from van der Waals' equation combined with Dupré's formula for the vapour pressure; and Batchinski also gives wrongly Bakker's theorem respecting the latent heat. [See Abstract No. 1033 (1903).] R. E. B.

ELECTRICITY AND MAGNETISM.

THEORY, ELECTROSTATICS, AND ATMOSPHERIC ELECTRICITY.

832. *On Magnetostriction.* **F. Kolaček.** (Ann. d. Physik, 13. 1. pp. 1–37, Dec., 1903.)—It is proposed in this paper to extend the laws of magnetostriction without making any assumption concerning the nature of the magnetic medium. The method adopted by Helmholz and Kirchhoff for dealing with discontinuities is to be followed, namely, every discontinuity is to be treated as a continuous variation, becoming very rapid at the surface in question. The first four sections contain the fundamental theory. The writer starts from the most general theory of attracting masses as obeying the Gauss law of the integral normal, namely, that—

$$4\pi\,\Sigma\,\text{Massen} = \int d\omega(u\cos nx + v\cos ny + w\cos nz),$$

where $d\omega$ denotes an element of a closed surface, n an element of the normal, Σ Massen is the sum of the contained masses, and u, v, w the components of magnetic induction. Whence also, if ρ denote the density, we have $4\pi\rho = \partial u/\partial x + \partial v/\partial y + \partial w/\partial z$. The energy W_1 per unit of volume is found to satisfy the equation $\partial W_1 = (1/4\pi)(X\partial u + Y\partial v + Z\partial w)$, X, Y, Z being components of magnetic force, derived from a single valued potential. The medium is supposed to be subject to external forces A, B, C, elastic forces and the like, while A′, B′, C′ are the magnetic forces which maintain equilibrium against them, so that $A' = -A$, &c. Also W_1 is supposed to contain certain magnetic constants, denoted generally by K, which may vary. The elastic displacements due to magnetic forces are ξ, η, ζ, whence we have generally $\int d\tau$, denoting integration throughout any space—

$$\int(A\partial\xi + B\partial\eta + C\partial\zeta)d\tau = \int d\tau\,\partial W_1,$$

and ∂W_1 is found to consist of three parts, which are separately calculated. In the fifth section the case is considered in which X, Y, Z are not derived from a potential. In section 6 the case of discontinuities is treated in the manner proposed at the outset. In section 7 the writer compares his method with that of Kirchhoff in the latter's work on magnetostriction. The case of an ellipsoidal solid is specially dealt with in sections 8 and 9, and subsequently that of a toroid. Reference is made to Nagaoka's investigations concerning an ovoid solid [see Abstract No. 879 (1901)], also to the case of a solid under torsion, and especially to the torsion of a wire carrying an electric current, due to its magnetisation in the direction of its length.

S. H. B.

833. *Concept of Work applied to the Magnetisation of Crystals.* **P. Weiss.** (Comptes Rendus, 138. pp. 35–37, Jan. 4, 1904.)—When a crystal is adiabatically magnetised by the approach of permanent magnets, the energy expended, or work done, is given by the formula (per unit volume) $E = -\int(I_x dH_x + I_y dH_y + I_z dH_z)$. Since E must be independent of the path, *i.e.*, dE a perfect differential, owing to the principle of energy, we must have $-\partial E/\partial H_x = I_x$; $-\partial E/\partial H_y = I_y$; $-\partial E/\partial H_z = I_z$. Accordingly, if we imagine the family of surfaces $E = \text{const.}$ constructed, the intensity of mag-

netisation will be given in direction by the normal to the surface $E = \text{const.}$ at the point $(H_x\ H_y\ H_z)$, and in magnitude by the rate of variation of E along the normal at that point. Integrating by parts, we can write—

$$E = -(H_x I_x + H_y I_y + H_z I_z) + \int (H_x dI_x + H_y dI_y + H_z dI_z),$$

where the first member on the right-hand side equals the mutual energy of the field and the magnetised body, and the second member (ϵ) the internal energy of magnetisation of the substance. Reasoning as before, we arrive at the conclusion that the magnetic field corresponding to a given value of the intensity of magnetisation is given in direction by the normal to the surface $\epsilon = \text{const.}$ at the point $(I_x\ I_y\ I_z)$, and in magnitude by the rate of variation of ϵ along this normal. The author concludes by discussing methods for determining experimentally the energy of magnetisation, and the application of the preceding principles to the magnetisation of a crystalline body such as pyrrhotine, which possesses a "magnetic plane" (in which $I_t = 0$). [The author does not appear to be acquainted with Duhem's thermodynamic theory of magnetism.] F. G. D.

834. *Study of the Electrical Conductivity of the Atmosphere in the Grotta di Bossea.* **G. B. Rizzo.** (Accad. Sci. Torino, Atti, 38. 15a. pp. 859–863, 1902–1903.)—The conductivity of the atmosphere in the grotto is measured at five different points, and in four cases it is found to be considerably greater for a positive than for a negative charge. In the remaining case, where it is greater for the negative charge, the ratio is 70·3 to 68·9. The air is found to be negatively charged, especially in the neighbourhood of a waterfall, where the atmosphere is laden with a fine mist due to the fall. The conductivity, or dispersive power, is measured by the rate of discharge of a conductor, the potential being observed by means of an electrometer. S. G. S.

835. *Atmospheric Electricity and Radio-activity.* **W. Saake.** (Phys. Zeitschr. 4. pp. 626–632, Sept. 1, 1903.)—Observations were made in the months of February, March, and April, 1903, at Arosa, an elevated valley in Switzerland, of the potential, the dissipation of electricity, and the radio-activity of the air. Negative values of the potential were found on clear and cloudless winter days. The mean values of the dissipation coefficient for Arosa in the months mentioned were for $a-$, 1·97, and for $a+$, 1·61. The moist south wind increased the values of the coefficient for both kinds of electricity. Mist had the opposite effect. The daily variation of the quantity $a-$ shows a maximum in the morning about 8 a.m., and one in the evening between 4 and 5 p.m.; between these there comes a midday depression. The curve for $a+$ shows a maximum about 9 a.m. The amount of radio-active emanation in the atmosphere is at Arosa about three times greater than at Wolfenbüttel, and about nine times as great as at Juist on the North Sea coast. Increased radio-activity in the air did not appear to coexist with increased electrical dissipation or increase of conductivity. On clear days larger values of the induced radio-activity of the atmosphere were observed than on dull days. The south wind appears to diminish the value of A, the activity coefficient. The curve of the daily variation of the magnitude A shows a culmination point somewhat after midday, and a sudden falling off after sunset. Under the influence of the earth's electric field, considerable quantities of radio-active substance are deposited upon resistances within

reach of the lines of force. It is suggested that the deposit of radio-active substances upon the human body may have some therapeutic value, and be a factor in the influence of health resorts at high altitudes. J. J. S.

DISCHARGE AND OSCILLATIONS.

836. *Conductivity and Residual Ionisation of Paraffin Wax under the Influence of Radium Radiations.* **H. Becquerel.** (Comptes Rendus, 136. pp. 1173–1176, May 18, 1903.)—The author refers to the effect noticed by J. J. Thomson that a conductor covered with paraffin wax discharges itself on exposure to Röntgen rays; to the author's own observations that such conductivity in a gas persists after the radiations are stopped, and, as well, to Curie's observations on the ionisation of liquid dielectrics. He now describes some experiments on the conductivity imparted to paraffin wax by the radium rays. The experiment was made by placing a cylindrical copper-foil sheet in a glass tube 3 cm. diam. and then putting a cylinder of aluminium-foil in the central axis, coaxial with the copper. Inside the aluminium cylinder was a small test-tube in which the active material could be placed. Melted paraffin wax was then poured in. A small quantity of radium chloride in a glass tube was employed. The copper was connected to a water battery of 100–200 cells, the aluminium being insulated but connected to one terminal of a gold-leaf electroscope. In the absence of radium no current could be detected, but as soon as the tube of radium was placed in the hole in the aluminium, the leaves rapidly diverged. The effect is due to the penetrating rays which pass through the glass, the aluminium, and a thickness of the wax, as well as to the more absorbable secondary radiations which produced disturbing effects on the readings. As soon as the radium was removed, these disturbances vanished, and the electroscope showed a progressively diminishing current. In this experiment the wax is charged, but if one now puts the copper and aluminium to earth and then insulates the aluminium, this latter will begin to charge itself in the opposite sense to the former charge. This may be due to the disappearance of the polarised state of the dielectric or to the feeble residual ionisation. If the radium is now again introduced, the new ionisation produced gives rise to a rapid recombination of the liberated charges, and a considerable current is observed, which becomes very feeble after a few seconds. To see whether the molecular state of the wax had any influence, it was kept for a whole year, when the experiments were repeated under the same conditions. The results obtained, given in tables, are almost identical, the effect observed increasing with the time of exposure to the radiation, and curves representing these results are hyperbolic in form, as are those representing the combination of gaseous ions. The author finally considers that effects of the same order are probably produced in all solid, as well as liquid and gaseous, dielectrics. [See also next Abstract.] L. H. W.

837. *Effect of Kathode and Radium Rays upon Solid Dielectrics.* **A. Becker.** (Ann. d. Physik, 12. 1. pp. 124–143, July 21, 1903; and 13. 2. pp. 394–421, Jan., 1904.)—The dielectric, in the form of a sheet, is placed between two metal plates, one of which is of aluminium. This condenser is connected to a battery and to an electrometer. The potential difference at the terminals of the condenser is noted at successive equal intervals of time: (1) Under normal conditions; (2) when the aluminium plate is

exposed to the rays. The author considers that his results indicate the existence of conducting currents accompanying the radium rays, but that the increase of conductivity is less marked with solid dielectrics than with gases. He arrives at a similar result for kathode rays. The observed differences recorded in the paper are, however, rather too small for conclusive generalisation. Paraffin condensers are used for most of the work, and the author appears to assume throughout that there is no surface leakage between the condenser plates. [See also preceding Abstract.] R. A.

838. *Positive Ionisation Produced by Hot Platinum in Air at Low Pressures.* **O. W. Richardson.** (Phys. Soc., Proc. 18. pp. 524–542, Nov., 1903.)—The leak from a hot platinum wire positively charged and surrounded by air at a low pressure was investigated. A spiral of wire in the first experiments was heated by an electric current, its temperature being determined by means of its resistance. The wire was supported above the axis of a cylindrical electrode from which it was insulated. The cylindrical electrode was joined to the insulated quadrant of an electrometer, the other quadrant being earthed, and the wire raised to any desired positive potential. The vacuum tube containing the spiral and electrode was connected with a Töpler pump and McLeod gauge. In later experiments two spiral electrodes of fine platinum wire were placed parallel to each other and about 1 cm. apart in a vessel which could be exhausted. The experiments carried out show that the positive leak from a hot platinum wire at low pressures is not a definite function of the temperature, but that it gradually decays with time. The complexity of the phenomena seems to indicate that in general the ionisation is produced by more than one substance, but where one effect is predominant, the rate of decay of the leak is proportional to its value at the time considered. At a constant temperature the induced leak thus falls away as a negative exponential function of the time. Further, a wire which has been heated at a given temperature until it has lost the power of discharging positive electricity, may have that property restored to it by any of three agencies: (1) Exposure to air; (2) exposure to the positive discharge from a second hot wire; and (3) making it an electrode during the passage of a luminous discharge. The first and third methods lead to the conclusion that the effect is due to gas. This gas must, however, be in a peculiar state, since the experiments show that none of it comes off the wire negatively charged. In the case of the second and third methods the induced activity is much greater when the wire is made the negative electrode. This might indicate that it is due to the positive ions, but this supposition is rendered untenable by the fact that Röntgen-ray ions produce no effect. The fact that the discharge induces more activity on the negative than on the positive electrode leads to the conclusion that there are more gas molecules in the state necessary to produce the effect in the neighbourhood of the negative than in that of the positive electrode. These effects have been shown to happen between 0·001 mm. and 0·3 mm. pressure, but there is no reason to believe that similar phenomena would not occur at higher pressures. When a "revived" wire is heated at a constant temperature, the induced activity is gradually dissipated. In every case the activity fell off in such a manner as it would if the rate of decrease were proportional to the activity momentarily present; in fact the phenomenon is exactly analogous to a monomolecular chemical reaction. The quantity which corresponds to the velocity of the reaction is probably a function of the pressure of the gas and of the temperature of the wire. In air at atmospheric pressure the falling off of the conductivity with time is much slower than at low pressures. The greater persistence of the positive leak at high pressures is probably to be attributed either to the greater difficulty experienced by the induced activity in diffusing away or to the fact that a new active layer is continually being re-formed on the wire.

J. J. S.

839. *Action of Radium on Vacuum Tubes Submitted to a Potential Difference.* **D. M. Sokoltzow.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 35. No. 9b. p. 701, 1903. Paper read before the Russian Physico-Chemical Society (Physics Section), Nov. 11–24, 1903.)—Vacuum tubes are frequently used as detectors of electromagnetic fields, the presence of which is indicated by the luminescence of the tube. To obtain this effect the intensity of the field must be upwards of a certain minimum value characteristic of each individual tube. Ionisation of the gas contained in the tube will take place, attended by a discharge phenomenon through the gas, corresponding to the luminosity observed; the field thus acts as an ioniser. If the field intensity be too weak to produce this ionisation, the action of another ioniser may be resorted to. It occurred to the author to use radium to increase the sensitiveness of the tube. The latter was placed under the influence of an electric field so weak as to make any luminosity impossible; as soon, however, as radium rays were allowed to act on the tube, a luminosity was noted, increasing with increase in the effectiveness of the radium. A. G.

840. *Radiation from the Arc.* **W. Hallwachs.** (Ann. d. Physik, 13. 1. pp. 38–64, Dec., 1903. Phys. Inst. d. techn. Hochschule, Dresden, Oct., 1903.)—The object of the paper is to determine whether the ultra-violet radiation has its source in the positive crater, as has most of the energy contained in the visible spectrum. The photo-electric effect on plates of copper oxide is tested in different positions, the conclusion being that the arc itself is the source of the photo-electrically active radiations. The intensity of the radiation depends in a linear manner on the voltage; curves are given illustrating this. If T be the time it takes a test plate to leak through a definite range of volts, $i =$ current in amperes, $p =$ volts on the arc, and $T_0 =$ a constant for the apparatus, then the equation $T = T_0/(i - 5{\cdot}3)\left(\frac{1}{\sqrt{p} - 44{\cdot}7} - 0{\cdot}058\right)$ represents the results of the observations with great accuracy. R. S. W.

841. *Photo-electric Discharge from Metallic Surfaces in Different Gases.* **W. M. Varley.** (Roy. Soc., Phil. Trans. 202. pp. 439–458, Dec. 11, 1903.)—The experiments described were designed to study the dependence of the magnitude of the photo-electric current from a metal surface illuminated by ultra-violet light (the Hallwachs effect) on the pressure and nature of the gas in which the illuminated surface is enclosed. The most constant source of ultra-violet light was found to be an electric arc between iron terminals in an atmosphere of hydrogen. The metal surfaces between which the leak of electricity was observed in one set of experiments were a piece of fine copper gauze and a metal plate (usually zinc) facing it at a short distance, surrounded by a gaseous atmosphere which could be maintained at various pressures. By means of a battery of small secondary cells the potential difference between the electrodes could be varied up to about 380 volts. The current between the electrodes was measured by means of a quadrant electrometer. The results obtained are recorded in a series of tables and curves. The first result given by Stoletow—that when the potential is kept constant and the pressure gradually decreased, the current first increases, reaches a maximum and then decreases towards a finite limit which is independent of the potential within very wide limits—is confirmed. The second result given by Stoletow—that at ordinary pressures the current increases slowly with the p.d., approaching a kind of saturation which is more marked at low pressures—needs modification. At a few mm. pressure there does not appear to be any approach to saturation. At a pressure of about $\frac{1}{10}$ mm. (depending on the distance between the electrodes) a true saturation current which decreases with the pressure is obtained. This approaches a finite value as the pressure is indefinitely decreased. Except for the fact that at the higher pressures no true saturation current exists, the results obtained can be simply explained by the ionic theory of conduction. The metal surface illuminated by ultra-violet light may be regarded in a similar manner to a hot surface, and it may be supposed that negative corpuscles escape from the surface under the influence of light, and, in the absence of any force tending to drag them further, simply diffuse back into the metal. If now the illuminated surface is negatively charged, a field is set up, and the corpuscles are enabled to escape, and a state of equilibrium will be established where the total number of corpuscles given out by the metal is equal to the sum of the number finding their way to the positive electrodes and the number diffusing back into the metal; and, as the field is increased, the latter number will become small compared to the former, and there will be a saturation current—neglecting, of course, any complications introduced by the presence of the surrounding gas. Although a saturation current is never obtained at the higher pressures, yet at all pressures the current-e.m.f. curve is less steep as soon as a certain potential gradient has been reached. As the potential difference is further increased, the current increases more slowly, but uniformly, with the potential difference, until another critical potential gradient has been reached, beyond which the current increases much more rapidly than the potential difference, and this rapid increase goes on until an actual spark discharge takes place between the electrodes. The fact that the current-e.m.f. curves are not horizontal, even when saturation might be expected, and that they become steeper and steeper at their flattest parts as the pressure is decreased, seems to indicate that there is ionisation by collision to some extent at gradients much below those at which the second rise in the curve leading up to the spark discharge commences. When the pressure is decreased below a few tenths of a millimetre, the character of the curves alters completely, and perfect saturation currents begin to be obtained. This critical pressure corresponds to that at which the mean free path of the ions becomes comparable with the distance separating the electrodes. As soon as this is the case, the number of molecules which can be struck by the corpuscles shot off from the illuminated electrode becomes very limited, and a small potential gradient will be sufficient to cause saturation. Further lowering of the pressure will decrease this saturation current, until at very low pressures the whole current will be practically due to the corpuscles shot off from the kathode, as only a very small fraction of these will strike a molecule in the course of their journey from one electrode to the other. The curves at the very lowest pressures agree with Lenard's result [see Abstract No. 1845 (1900)] for kathode rays produced by ultra-violet light—that in a vacuum a very large change in the potential difference produces no change in the current. The curves showing the relations between the photo-electric currents in the three gases, air, hydrogen, and carbon dioxide, all show that at the higher pressures the current is greater in carbon dioxide than in air, and greater again in air than in hydrogen for all potential gradients up to those at which the genesis of ions by collision begins. For pressures down to a tenth of an atmosphere the currents in carbon dioxide are approximately 1·75 times as great as those in hydrogen for all potential gradients for which the current lies on the more horizontal part of the current-e.m.f. curve, that is, for those currents nearest approaching to saturation. The currents in air are greater than those in hydrogen, though not nearly so great as those in carbon dioxide. At lower pressures the ratio becomes much less, at 18 mm. pressure the current in carbon dioxide being less than 1·5 times that in hydrogen, as before, for points lying on the less steep portion of the curve. At still lower pressures the ionisation by collision introduces complications, even with small potential differences, and soon becomes the dominant factor in determining the currents until the very lowest pressures are reached. At pressures below about 0·005 mm. the method employed ceases to be satisfactory, as the corpuscles given off by the kathode are shot right through the meshes of the gauze. J. J. S.

842. *Passage of Kathode Rays through Metals.* **E. Warburg.** (Deutsch. Phys. Gesell., Verh. 6. 1. pp. 9–32, Jan. 15, 1904. Phys. Instit. Berlin, Jan., 1904.)—If a bundle of kathode rays of a definite velocity be deflected by a magnetic field no spectrum is formed, *i.e.*, if they pass through a slit and fall on a fluorescent screen, then the image of the slit is of the same width when formed by the magnetically deflected as by the undeflected rays. This is not the case when they first pass through a thin metallic sheet, or when they are first reflected from a metallic surface. The greatest intensity of fluorescence in the spectrum of the reflected rays lies in the region corresponding to a velocity nearly equal to that of the direct rays; in the transmitted ray spectrum it corresponds to a smaller velocity. A great part of the paper is devoted to the mathematical development of a theory to explain these facts. A general, but not very satisfying, agreement between the theory and the results of some special experiments by Leithäuser is found.

R. S. W.

843. *Disturbing Action of the* S-*rays in Radiography.* **F. Dessauer** and **B. Wiesner.** (Phys. Zeitschr. 5. pp. 58–61, Jan. 15, 1904.)—Strong diffuse reflexion occurs with Röntgen rays. These diffusely reflected rays have been named secondary rays, or S-rays, and they interfere with the production of clear shadow pictures. The authors, with the object of getting sharply defined radiographs of the human body and penetrating the thicker bony portions, such as the pelvis, have devised a method of controlling the origination of the S-rays and separating them from the Röntgen rays. A circular opening is made in a sheet of lead, and in this a thick-walled metal tube is fixed. The Crookes tube is placed above the metal tube, and the fluorescent screen below. S-rays originate at the walls of the tube, but these cross the path of the Röntgen rays and are diffusely reflected in all directions. Below the lower opening of the tube a bright circle is formed, produced by Röntgen rays which reach the screen in a straight line through the tube. Outside this circle is a ring on the screen, formed by S-rays. By using two tubes one below the other with an interval between, the S-rays may be caused to pass out through this opening. Radiographs taken by means of the pure primary Röntgen rays thus obtained show the structure of the bones of the spinal column and of the lumbar vertebræ in living adults. J. J. S.

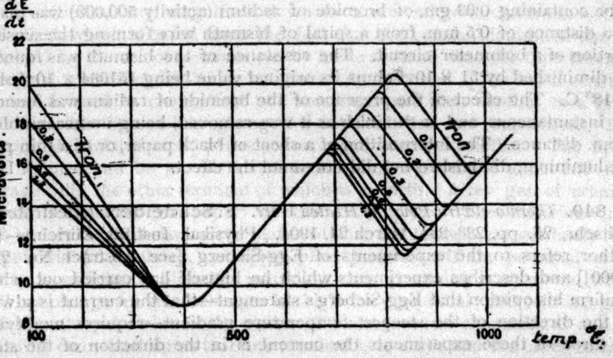
844. *Energy Relations in Oscillatory Magnetic Circuits.* **J. Zenneck.** (Ann. d. Physik, 11. 5. pp. 1121–1134, July 7, 1903. Physikalisches Institut, Strassburg.)—The author extends the analogy which he previously pointed out exists between alternating-current circuits and oscillatory magnetic circuits [see Abstract No. 742 (1903)], and obtains, by the use of the idea of magnetic inductance there defined, a simple expression for the energy expended, or Energieumsatz, in the circuit. This is applied to an investigation of the effect of cores of thin iron wires in coils both with slow and with high-frequency oscillations. Expressions are obtained for the increase of flux due to the core and the energy loss through eddy currents. With high frequencies ($n > 10^6$ per sec.) these expressions can be used for iron of mean μ (about 100) down to 1/10 mm. radius. In this case the flux increases with μ, but slowly; depends also, however, on the frequency and the radius, so that with increasing frequency, for each core there must come a point where the introduction of a core not only does not increase the flux but reduces it. With the same induction, the core loss is independent of μ and cannot be reduced much by reducing the diam. With the same current the loss is the greater the smaller the radius; the opposite to low-frequency currents. A number of values for frequency $n = 3 \times 10^6$ per sec. are then given in tables, as of interest in wireless telegraphy ($1/4\lambda = 50$ m.). As data for estimating the correction for hysteresis were lacking, the author made experiments with five similar cylindrical cores of solid iron, thick, thin, and very thin iron wire, and iron powder respectively. As regards the latter substance Braun [see Abstract No. 1252 (1903)] has given some figures. The method employed was very similar to Braun's. The increase of flux gave as ratios, for coils without and with each of the above cores, the values 0·66, 1·31, 1·73, 1·72, and 2·76 respectively, whilst the losses in the cores were respectively 4·5, 31, 41, 55, and 6. The author considers that even with iron powder the loss is too large to allow practical use to be made of it for increasing the flux, but the value of wire cores for choke coil and protective purposes is shown. [See also Abstract No. 1454 (1903).] L. H. W.

845. *Demonstration of Electric Waves along Wires.* **K. Schaum** and **F. A. Schulze.** (Ann. d. Physik, 13. 2. pp. 422–424, Jan., 1904. Also Sitzungsber. d. Ges. Naturw. zu Marburg, No. 8. pp. 121–127, Dec., 1902.)—The method of Arons and of Coolidge is improved on by covering the wires with some fluorescent material, which greatly improves the visibility of the nodes and antinodes. If a charged electroscope is brought near the antinodes of electric force, it discharges quickly with either a positive or negative charge; most quickly when the charge is positive. No change is noticed at a node. Condensation in a steam jet and the formation of ozone can also be detected at the antinodes. R. S. W.

ELECTRICAL PROPERTIES AND INSTRUMENTS.

846. *Conductivity of Selenium in Presence of Bodies Treated with Ozone.* **E. van Aubel.** (Comptes Rendus, 136. pp. 1189–1190, May 18, 1903.)—Red or black caoutchouc, placed in a current of ozone for 12 min. and then put near a selenium cell was found to reduce its resistance from 599,000 ohms to 556,000 in 15 min. On interposing a brass screen the resistance rose to 563,000 ohms in an hour, and regained its original value the following day. Camphor exposed to the ozone for 25 min. produced a rather greater fall in resistance of the cell. [See also Abstract No. 1438 (1903).] E. C. R.

847. *Thermo-electric Properties of Iron and Steel.* **G. Belloc.** (Annal. Chim. Phys. 30. pp. 42–98, Sept., 1903.)—The author reviews the methods adopted for examining the properties of iron and steel at different temperatures and the theories of the constitution of these metals. The thermo-electric method of Harrison is criticised, in that copper which is volatile above 900° C. was taken for the other metal. In the experiments described, a partial zero method was used in which, in measuring temperatures between 700° and 800° say, the e.m.f. corresponding to 700° was balanced by a potentiometer arrangement, and readings above this value taken by direct deflection. The electric furnace and the le Chatelier thermometer are fully described, also the experimental arrangements. The comparison metal was platinum, and the couple was placed in a vacuum continuously maintained, piano wire and flower wire being employed for the iron, and shavings about 2 mm. sq., chipped off in the cold from steel bars, for the steel. The resistances were regulated so that a steady, slow rise of temperature was maintained, and the same on cooling. The duration of the experiments was about 6 hours each time, and 1,100° was ordinarily the highest temperature attained. It was found that the e.m.f. curve in passing from iron to different kinds of steel is not altered, but simply displaced. Curves plotted from values of $\frac{dE}{dt}$, where E = e.m.f. in microvolts, show that there is (1) a minimum for all such couples about 380° corresponding to 8·75 microvolts; (2) a maximum the abscissæ of which are inversely proportional to the carbon content, the abscissæ and ordinates of which vary from 680° to 820° and 16–20 microvolts respectively; (3) a second minimum individual to each couple about 120° removed from the maximum, and the ordinate differing by about 4 microvolts from the maximum. From these results a curve of the theoretical e.m.f.'s according to the carbon content of the iron or pure steel specimen is deduced, reproduced in the Fig. The relations of the results to the critical points are investigated, and also the effect of other elements. Thermoelectric cycles are obtained with iron, which show that below 820° only one value of e.m.f. is obtainable for a particular temperature. Above 820° the ascending and descending curves differ, there being an advance, instead of a retardation as in ordinary physical viscous phenomena, due to the existence of α and β iron above this temperature, an excess of β iron over that required for equilibrium reducing, and an excess of α increasing, the thermo-e.m.f. Similar cycles were obtained



with steel, but difficulties of decarburisation were encountered, and the effects were complicated by the dissociation of the cementite. Above 1,250° the cycles closed in on themselves, this upper limit corresponding to the critical point a_4 of Hall and Curie. The experiments were repeated with tempered steel, and the effect of magnetism on the e.m.f. at 800° found to be considerable, as also was the effect of the number of reheatings. The conclusions from these latter results are: (1) Decarburisation (spontaneous) of steel takes place on heating above 800°, whatever the medium; (2) this phenomenon is related to the occluded gases; (3) the gases are more difficult to expel the less carbon the steel contains (as Troost and Hautefeuille, Comptes Rendus, 126. p. 19); and (4) in the absence of occluded gas [see Abstract No. 1481 (1903)], not only is the carbon not got rid of in heating, but there is even supercarburisation, due to the volatilisation of the iron in vacuo. A large number of tables and curves are given, and details of the precautions taken are included. L. H. W.

848. *Influence of Bromide of Radium on the Resistance of Bismuth.* **R. Paillot.** (Comptes Rendus, 138. pp. 139–140, Jan. 18, 1904.)—A thin glass tube containing 0·03 gm. of bromide of radium (activity 500,000) was placed at a distance of 0·5 mm. from a spiral of bismuth wire forming the sensitive portion of a bolometer circuit. The resistance of the bismuth was found to be diminished by 51×10^{-4} ohms, its original value being 151034×10^{-4} ohms at 18° C. The effect of the presence of the bromide of radium was found to be instantaneous, and to diminish as it was removed, being immeasurable at 1 cm. distance. The interposition of a sheet of black paper, or of a thin plate of aluminium, diminished but did not annul the effect. J. D. C.

849. *Thermo-electric Power of Heated Wire.* **F. Schneider.** (Elektrotechn. Zeitschr. 25. pp. 233–234, March 24, 1904. Physikal. Institut, Zürich.)—The author refers to the experiments of Egg-Sieberg [see Abstract No. 2215 (1900)] and describes experiments which he himself has carried out, which confirm his opinion that Egg-Sieberg's statement—that the current is always in the direction of the steepest temperature gradient—requires modifying. In three of these experiments the current is in the direction of the steep gradient, but in a fourth, in which two wires of the same material (iron), but of different diameters, were twisted, pressed, or soldered together, the current was in the opposite direction. This result could not be explained on Egg-Sieberg's hypothesis, but is to be looked for as a result of the contact of two chemically different bodies. In all the author's experiments it was found that the resistance of the couple rose after the heating, owing to the formation of oxide, &c., the current flowing from iron oxide to iron, and the reversal in the experiment with different sized wires is considered to be due to the greater heating and consequent oxidation of the finer wire (in a given time), and so the current must flow from the thin to the thick wire. Similar experiments were made with German silver, copper, and platinum wires. In no case was the p.d. dependent on the steepness of the temperature gradient, but those metals the structure of which underwent least change gave the smallest currents—as copper and platinum (with the latter 10 microvolts, as compared with 500,000 with iron). L. H. W.

850. *Measurement of Small Resistances.* **A. Campbell.** (Phys. Soc., Proc. 18. pp. 480–487, Nov., 1903.)—Given three manganin resistances purporting to be 0·1, 0·01, and 0·001 ohms respectively, it is desired to find

their values in comparison with three resistances 1, 1, 10 ohms respectively, whose true values are very accurately known. In doing so the following methods are used :—(1) Shunt potentiometer ; (2) Kelvin bridge ; (3) two-step bridge ; (4) differential galvanometer ; (5) Matthiessen and Hockin's method. This work and the results obtained serve to show which method is most reliable and convenient. The last method is found far inferior in accuracy to the others. Method (4) also seems to be inferior in applicability and sensitiveness. Of the other methods the two-step bridge is somewhat more sensitive but less convenient than the potentiometer and the Kelvin methods. The results are stated to six significant figures. An appendix is given on the sensitiveness of potentiometers for measuring resistance. P. E. S.

851. *Comparison of Capacities: An Application of Radio-active Substances.* **J. A. McClelland.** (Roy. Dublin Soc., Proc. 10. 18. pp. 167–177, Feb. 26, 1904.)—The author refers to the methods of Fleming and Clinton [see Abstract No. 153 (1904)] and of Stroud and Oates [see Abstract No. 611 (1904)] as illustrations of the difficulty of obtaining accurate results, at any rate without elaborate apparatus. A method suitable for the determination of capacities of any magnitude down to a few micro-microfarads is then described, which is based upon the fact that the constant ionisation current obtained by the use of uranium can be made so small that the time taken to charge a condenser by it can be accurately measured. The small constant current is used to charge first one condenser and then another, to a given potential, the time taken giving the ratio of the two capacities. Two horizontal insulated metal plates are arranged over one another. The upper one of these can be joined to one terminal of a battery of about 100 small storage cells, the other terminal of which is to earth. A few gm. of uranium nitrate are placed (on paper) on the lower plate. The radiation from this ionises the air between the plates, so that the lower plate gradually rises in potential (if insulated, and upper plate positive). If the potential at the plates is sufficiently high, the ionisation current attains a maximum which will not change for small changes in the battery potential; 200 volts is a good value for the p.d. between the plates. To compare two capacities, C and C_1, C is first connected up so that one terminal is to earth and the other to earth through a bridged pair of mercury cups, as well as to the insulated terminal of the condenser and one terminal of the quadrant electrometer (the other terminal being to earth). As soon as the bridge is removed from the mercury cups, the lower plate and the electrometer begin to charge, and the time is noted during which the spot moves over, say, 100 scale-divisions. This is repeated with the other condenser C_1. If the times are t and t_1, respectively $(C + C)/(C_1 + C) = t/t_1$, where C is the capacity of electrometer, condenser and connections. C can be determined by comparison with a known capacity, or in terms of C; thus the ratio C/C_1 is obtained. The author prefers uranium as it gives off no emanation. Some experiments are described, made by this method, and the results shown in full. From these the author considers that the method is capable of measuring with considerable accuracy a capacity of 1 micro-microfarad or even less. The only precaution needed is to screen the space between the plates from air currents, which, if strong, might blow away the ionised air and reduce the ionisation current. L. H. W.

852. *New Form of Wheatstone's Bridge.* **M. T. Edelmann.** (Phys. Zeitschr. 4. pp. 675–676, Oct. 1, 1903. Communication from the Physikalisch.

Mechanisches Institut.) — The aim of the designer has been to secure reversal of the ratio arms, the galvanometer, and the battery without unscrewing any plug in the instrument itself. The ratio arms are parallel and terminate in a commutator, the battery and galvanometer circuits also containing external reversing keys. The galvanometer circuit is closed by a successive contact key having a 10,000 ohm coil underneath, so that the sensitiveness may be altered to suit the reversal of the ratio arms. The range of the instrument is from 0·0001 ohm to 21,111,000 ohms. [See also Abstract No. 830 (1903).] E. S. A. R.

853. *Resistance Bridge with Reversible Ratio Arms.* (Phys. Zeitschr. 5. pp. 50–51, Jan. 15, 1904.)—A scheme of connections is shown for Edelmann's pattern of bridge as made by the firm of Hartmann and Braun. The apparatus differs from the original pattern owing to the ratio arms being placed in the centre, and a reversal brought about by means of a double plug connection. The lower resistances, up to 300 ohms, are wound in bifilar fashion, and the remaining coils are also corrected for induction and capacity effects. [See also Abstract No. 830 (1903).] E. S. A. R.

854. *Potentiometer for Thermo-electric Work.* **J. A. Harker.** (Phys. Soc., Proc. 18. pp. 473–479 ; Discussion p. 479, Nov., 1903.)—This potentiometer has three rows of resistances, the units in each being 0·01, 0·1, and 0·01 ohm, while the slide wire is 0·02 ohm, and is placed as a shunt to any two of the row having 0·02 ohm resistance. The method is to join any desired coil to the slide wire by means of stout copper bus-bars so as to get the resistances in use in series with one another ; $\frac{1}{40}$ microvolt is the smallest voltage measured. Copper-mercury cups of special construction are used for connections. Only copper and manganin occur in the circuit, and the slide wire is gilt. A special device was adopted to insure that the slide wire is exactly equal to two of the 0·01 ohm coils. The slide wire is made slightly more than 0·02 ohm, and a shunt of 4 ohms is inserted in the ebonite contact handle. Suppose the relation of the slide-wire to the coils changes, it is only necessary to vary the shunt ; whereas otherwise a new slide-wire would have to be used. A discussion follows. P. E. S.

855. *Potentiometer for Thermo-couple Measurements.* **R. A. Lehfeldt.** (Phys. Soc., Proc. 18. pp. 469–473 ; Discussion, p. 479, Nov., 1903.)—It is essential that there should be no high resistance in the circuit of couple and galvanometer. A very long scale potentiometer is specially made, only copper and manganin being included in the main circuit. The slide wire, which is gilt, is 10 cm. long, and a vernier enables $\frac{1}{40}$ mm. to be read on it. Each vernier division corresponds to $\frac{1}{400}$, $\frac{1}{40}$, or $\frac{1}{4}$ microvolt, according to which connection is made on the apparatus. The potentiometer is put into a box filled with paraffin-oil to keep the temperature constant, and care is taken to have the places where the leads from the thermo-couple join the potentiometer wire deep in the box and near together. The method of calibration is described. A discussion follows. P. E. S.

856. *Oscillation Galvanometer.* **E. F. Huth.** (Phys. Zeitschr. 4. pp. 640–641, Sept. 15, 1903.)—The author points out that he designed a quantitative detector of electric waves before that described by Fleming [see Abstract No. 372 (1904).] In the author's instrument (also making use of the Ruther-

ford solenoidal detector principle) a bundle of 80 steel wires, 0·1 mm. diam. and 16 mm. long, are suspended by a phosphor-bronze wire, the suspended system being provided with paper wings for damping. A magnetising current is applied, and the bundle being magnetised, seeks to place itself in the magnetic meridian, twisting a torsion spring provided until the couples balance. On waves arriving, the demagnetisation of the core produces a change in the deflection, which is read by means of a mirror, spot and scale. The author has also obtained deflections in the opposite direction, *i.e.*, indicating a magnetising instead of a demagnetising effect, when the waves have arrived while the magnetising current was still on. As a gauge of the sensitiveness obtained, it is mentioned that with antennæ of 250 cm. and a distance of 220 cm. between transmitter and receiver, a deflection of 250 mm. on the scale (175 cm. away) was obtained. The voltage at coil is given as 14 volts, and the spark was in air, but the length of spark is not stated. The author has made a number of measurements with the instrument, and promises to describe these fully in a later paper. L. H. W.

857. *Electric Wave Detector.* **J. A. Ewing** and **L. H. Walter.** (Roy. Soc., Proc. 73. pp. 120–123, March 7, 1904. Electrician, 52. p. 783, March 4. Mech. Engin. 13. pp. 413–414, March 19. Elect. Rev. N.Y. 44. pp. 467–468, March 26, 1904.)—The authors, believing that the principle of an instrument devised by Ewing for the measurement of hysteresis, by utilising the dragging effect, on a mass of iron, of a revolving magnetic field, might be adapted to the detection of electric waves, describe experiments made for the purpose. It was found, as anticipated, that the deflection due to normal hysteresis was diminished under the influence of electric waves when the oscillations were led through a winding at right angles to the plane of the longitudinal magnetisation. The effect was then tried of allowing the waves to traverse the iron itself in the form of a coil of insulated iron or steel wire. The quite unexpected result was a very largely increased deflection, especially with the steel wire. The authors attribute this augmentation of the hysteresis to the longitudinal magnetisation being facilitated by the oscillatory circular magnetisation, to such an extent as to much more than overcome the direct effect of the waves in causing a diminution of hysteresis. The apparatus finally arrived at is described and illustrated. It has the great advantage of giving quantitative readings, and may be made nearly as sensitive as the average coherer. By means of a variable shunt, the sensitiveness may be diminished to any desired extent.

G. W. de T.

ALTERNATING CURRENTS AND MAGNETISM.

858. *Resistance Change in Nickel Wire when Transversely Magnetised.* **C. G. Knott** and **P. Ross.** (Roy. Soc. Edinburgh, Proc. 24. pp. 501–504, 1902–1903.)—The nickel wire, wound into a spiral coil, was placed in the air-gap of a powerful electromagnet. In one sample of nickel wire employed, an increase in resistance rising to a maximum was observed in fields below 1,500; above this strength of field a diminution of resistance was always observed. In another sample of nickel wire the increase of resistance in fields below 1500 did not appear. The experiments appear to indicate that in fields below 1500 the change in resistance due to transverse magnetisation is very small (probably a decrease); but that in higher fields the change (decrease) accompanying magnetisation increases rapidly with increase of

field. The changes in the lower fields are so small that a very small component of longitudinal magnetisation, which produces increase of resistance, is apparently sufficient under certain circumstances to counterbalance the decrease due to the transverse effect. If this be the explanation of the maximum (of increase) obtained in certain cases, then it follows that the transverse effect preponderates greatly in the higher fields. [See also Abstract No. 1071 (1903).] E. C. R.

859. *Magnetic Properties of Ferro-Magnetics and Alloys at very Low Temperatures.* **K. Honda** and **S. Shimizu.** (Mathematical and Physical Soc., Tokyo, 2. 3. pp. 31–39, 1903.)—Previous papers [see Abstract No. 166 (1904)] have shown the kind of work done. In this case comparison is made between the magnetic properties at 0° and at —186° C. Some remarkable results are published. *Magnetisation of Ferro-magnetics.*—In some cases the magnetisation increases and in some cases it decreases at —186° by as much as 50 per cent. *Magnetisation of Nickel Steels.*—A graded series of twelve of these (24 to 70 per cent. nickel) is used. In the case of the 26·64 per cent. alloy the magnetisation for one field increases as much as 80 times. Other large changes are shown. *Length Change in Ferro-magnetics.*—A change of 10 per cent. is common, but cobalt shows much greater changes in passing from one to the other temperature. *Length Change in Nickel Steels.*—The effect is parallel to that of magnetisation, the same striking differences existing for the 26 per cent. variety according as it is at 0° or —186°.

P. E. S.

860. *Action of a Magnetic Field on the Infusoria.* **C. Chéneveau** and **G. Bohn.** (Comptes Rendus, 136. pp. 1379–1380, June 22, 1903.)—The authors refer to the experiments of du Bois, who found that no effect on the movements of various Protozoa was observable in a magnetic field of 50,000 c.g.s. It was thought that these negative results might be due to the neglect of time as a factor. In the experiments here detailed two different electromagnets were used, giving fields of 5,000 and 8,000 c.g.s. respectively. Control specimens were employed in all cases. The general results noted were a slowing of the ciliary movements from the second day onwards. Growth and multiplication were also affected, the peculiarities of senescence being rapidly induced. Death finally took place, there being no tendency to rejuvenation by conjunction. With vorticellæ the colouration changed, indicating a progressive chemical alteration of the protoplasm. L. H. W.

861. *Comparison of Methods of Reducing Magnetic Hysteresis.* **C. Maurain.** (Comptes Rendus, 138. pp. 751–754, March 21, 1904.)—The author reviews the various methods which have been adopted by different experimenters to obtain the same curve with increasing as with decreasing fields, such being practically the normal curve of magnetisation defined in Abstract No. 376 (1904). He then employs (1) an alternating field of decreasing strength, giving a curve A; (2) the reducing action of a decreasing alternating current through the core, giving a curve B; (3) an oscillatory field of decreasing amplitude, giving curve C; and (4) an oscillatory decreasing current, giving curve D. These four curves were plotted for a series of specimens (iron and steel), and a comparison shows that in general the four curves A, B, C, D, for the same core do not coincide; they have the same appearance, but are yet distinctly different. They are in the same sequence in all the specimens; the highest is C, then D, then B, and lastly A. The relative differences are large for weak fields (10 to 20 per cent.), but diminish as saturation is

approached. For certain iron wires B and A are practically the same; C and D, however, are distinctly above these. The author considers that these results show that the phenomena of hysteresis are very complex, and he expresses doubt as to the possibility of an experimental definition of the normal curve of magnetisation. L. H. W.

862. *Analyses of the Kew Magnetograph Results*, 1890 *to* 1900, *and Sun-spot Relations.* **C. Chree.** (Roy. Soc., Phil. Trans. 202. pp. 335–437, Dec. 10, 1903. From the National Physical Laboratory.)—With the assistance of T. W. Baker, G. Badderly, and B. Francis, the author has analysed the results from the Kew magnetographs on the selected five quiet days of each month of the eleven years' period, 1890 to 1900. He measures declination positively to the west, and divides the year into three seasons of winter, summer, and equinox months (March, April, September, October). The rate of secular change of the declination has slackened since 1896, and these changes are not particularly large in years of sun-spot maxima. It has resulted that the temperature changes in the basement of the Observatory do affect the vertical component, and the records previous to 1897 have therefore been corrected. The paper discusses the annual inequality, the non-cyclic effects, and the periodic solar diurnal inequality with the aid of tables, curves, vector diagrams, and Fourier series. The variability of the declination or mean change per minute yields the average value 3·93″; it has decreased since 1896 from 3·24″ to 2·22″. In addition to hourly values, the tables give the ranges of the inequality, the differences between the algebraically greatest and least of the mean hourly values. These ranges are also found useful in the discussion of the sun-spot relations. [See Abstract No. 1253 (1903).] The author accepts Wolfer's frequency numbers, and again reverting to vector diagrams and Fourier series, he arrives at the conclusion that the relation between sun-spot frequency and magnetic phenomena varies considerably with the season, and may be expressed by the formula $R = a + bS$, where R is the range of a magnetic element, S the frequency, and a and b are constants for the particular month. For theoretical considerations the ratio b/a seems to be important; for navigation and survey, a. Reference is made to Börgen's magnetic observations at Wilhelmshaven, 1889 to 1895, and to Moureaux' work at Parc St. Maur. The high sun-spot frequency of the years 1892 to 1895 influenced both the non-cyclic effects and variability of declination equally, and they appear therefore to have a common source and be true manifestations of terrestrial magnetism. The author proceeds to an examination of the relations between the magnetic and meteorological phenomena, especially temperature and barometric pressure, and he points out that the amplitude ratios of the various Fourier series terms do not support the assumption that the source of the diurnal inequality in magnetism—due in some way to the sun—could be found in the direct diurnal heating and cooling of the earth. H. B.

ELECTROPHYSIOLOGY AND ELECTROTHERAPEUTICS.

863. *Thermal Behaviour of the Electrical Organ of the Torpedo.* **J. Bernstein** and **A. Tschermak.** (Preuss. Akad. Wiss. Berlin, Sitz. Ber. 8. pp. 301–313, Feb. 11, 1904.)—In order to trace the source of the difference of potential within the electrical organ of a torpedo, the thermal behaviour on stimulation was examined, and the organ was found to act much more like

nerve tissue than muscle; it shows no variation of temperature on stimulation and behaves generally like an endothermal cell, and more especially like a concentration-cell which acts by osmotic forces; the p.d., indeed, of the latter should be proportional to the absolute temperature, and that of the organ follows this law very nearly. Weyl has shown that stimulation decreases the amount of salts contained in the organ and increases that of phosphoric acid: this is doubtless due to the osmotic action of the membranous tissue of the organ. R. E. B.

864. *New Method of Using Diaphragms in Radiography.* **O. Pasche.** (Archives d'Él. Médicale, 11. pp. 259–263, May, 1903.)—Two diaphragms are employed, one between the tube and the part of the body to be photographed, and a second between the photographic plate and an aluminium support on which the part rests. The opening in the second is larger than in the first, and bears a definite relation to it in size. By means of a mechanical arrangement the two diaphragms are moved in the same direction, but at different speeds, in such a way that a shadow of each portion of the object is thrown successively on the plate. Blurring of the negative from diffusion is thereby prevented, and the method is especially useful in photographing the abdomen and pelvis. The author has found that the narrower the openings in the diaphragm are made, the more distinct is the radiograph obtained, though the duration of the exposure is necessarily lengthened. H. W. P. Y.

865. *New Röntgen-ray Tube for Radio-therapy.* **Oudin.** (Comptes Rendus, 137. pp. 891–892, Nov. 23, 1903.)—The tube is of the type known as Chabaud-Villard, but has opposite the anti-kathode a prolongation varying in length from 5 to 10 cm. and in diameter from 15 to 35 mm., according to the particular part of the body to be treated. This is provided with a sheath of ebonite or celluloid filled with vaseline or some other insulating fluid to prevent sparking. The tube itself is made of thick glass rich in lead, but the extremity of the prolongation is of ordinary glass. H. W. P. Y.

866. *Treatment of Cancer by Röntgen Rays.* **W. J. Morton.** (Röntgen Ray, Archives, 8. p. 103, Nov., 1903.)—The earlier the rays are employed the more confident we may be of success. Every case should be treated after operation, to prevent recurrence. Treatment may be pushed until a very severe dermatitis of the overlying skin is produced. In carcinomata of the breast the rays should be applied behind the scapula as well as from the front. The author thinks that the rays establish a mild leucocytosis which enables the tissues to overcome the cancerous cell-proliferation.

H. W. P. Y.

867. *Observation of the Stomach during Digestion by Means of Röntgen Rays.* (Röntgen Ray, Archives, 8 pp. 132–133, Jan., 1904.)—A meal of bread and milk mixed with subnitrate of bismuth was administered to a cat, and by this means an outline of the animal's stomach became visible on the screen of the Röntgen-ray apparatus. For a few minutes the shadow, which was pear-shaped, remained quiescent, but after this period a series of waves, recurring at intervals of ten seconds, could be seen starting near the centre of the organ and moving towards the smaller end. The waves continued until the stomach was emptied, and during a single period of digestion they reached a total of 2,600. It was seen that the cardiac end acted as a reservoir while

the churning movements were confined to the other half of the organ. When the animal became angry the waves ceased. These experiments were first performed by W. B. Cannon, of the Harvard Medical School, and have since been duplicated by Roux and Balthazard. H. W. P. Y.

REFERENCES.

868. *Potentials of Higher Orders.* **E. Daniele.** (Accad. Lincei, Atti, 12. pp. 453–462, Nov. 22, 1903.)—The author extends the results of Riemann and Neumann, keeping particularly in view those which are capable of direct physical interpretation. A number of interesting expressions are obtained relating to the kinetic potential of a moving system. J. E.-M.

869. *Rocket Lightning.* **J. D.** and **W. H. Everett** and **W. A. Lee.** (Nature, 68. p. 599, Oct. 22, 1903, and 69. p. 224, Jan. 7, 1904.)—On July 22, 1903, W. H. Everett observed at Sibpur, near Calcutta, luminous trails, like ascending rockets, shoot up immediately after lightning-flashes. Lee noticed at Calcutta apparently ascending flashes, but not anything suggesting rockets. J. D. Everett remarks that the latter phenomenon may have been invisible at Calcutta. H. B.

870. *Cause of Atmospheric Electricity.* **G. Simpson.** (Nature, 69. p. 270, Jan. 21, 1904.)—The author suggests that the sun continually emits Becquerel rays consisting of positive and negative electrons ; the atmosphere absorbs chiefly the positive electrons, while the negative ones reach the earth. If the charges were not dissipated, the potential gradient would continue to increase, and we know from observations that the potential gradient rises when the dissipation is reduced. H. B.

871. *Lightning at Close Quarters.* **F. H. Hadfield.** (Elect. Rev. 54. p. 280, Feb. 12, 1904.)—The author has, in South Africa, several times seen lightning strike within a few feet of himself, and alludes also to a display of St. Elmo's Fire observed on board during a thunderstorm in the Bay of Biscay. H. B.

872. *Electric Waves.* **H. Veillon.** (Archives des Sciences, 15. pp. 481–501, May, 1903.)—An account of various fundamental experiments with electric waves, the coherer being used as detector and measurer. In some of these, including the effect of a grating, the results were as expected from the optical analogy. But in the case of interference by a Lloyd's mirror the expected phenomena were not obtained. A provisional hypothesis is suggested to explain these anomalous results, but it admittedly needs confirmation by other methods of investigation. E. H. B.

873. *Repulsion of the Anode Light by Kathode Rays.* **Salles.** (Comptes Rendus, 136. pp. 1061–1062, May 4, 1903.)—An account of observations which show that in a Crookes tube the kathode beam acts upon the anode light, causing repulsion. When it is arranged that the anode is sheltered from the kathode radiation, the anode light is clearly observable. J. J. S.

874. *Production of Revolving Fields by Sinusoidal or Damped Oscillatory Currents.* **O. M. Corbino.** (Atti dell' Assoc. Elettr. Ital. 7. pp. 637–658, Nov.–Dec., 1903. Read before the Sezione di Palermo, Dec. 8, 1903.)—A theoretical analysis of the production of revolving fields by oscillatory fields, sinusoidal or damped. The author gives a complete discussion of the possibility of producing two equal currents, the one lagging by an angle of 90°, in a circuit with inductive resistance and capacity, when the frequency depends upon the circuit itself, as in the case of Duddell's sinusoidal currents or of other damped electrical oscillations (as those used by Artom) to produce a revolving field. E. R.

875. *Vacuum Tubes with only one Electrode.* **K. v. Wesendonck.** (Ann. d. Physik, 13. 1. pp. 205–209, Dec., 1903.)—In certain circumstances the single electrode gives both anodic and kathodic effects. R. S. W.

876. *Electrical Conduction in Flames.* **H. Starke.** (Deutsch. Phys. Gesell., Verh. 6. 1. pp. 33–43, Jan. 15, 1904. Physik. Instit. der Universität, Berlin.)—A further contribution to the already long polemic with Marx on the subject. [See Abstracts Nos. 354, 394, and 395 (1904).] R. S. W.

877. *Production of very High Voltages by Alternating Currents.* **W. Wien.** (Phys. Zeitschr. 4. pp. 586–587, Aug. 1, 1903.)—The author points out that 10,000 volts is about the limit of voltage obtainable with a dynamo or battery. To obtain higher voltages he proposes to employ alternating current to supply a spark-coil. A description is given of a special 4-kw. alternator, having 36 poles, built for him by Schuckert, of Nürnberg, giving 1,200 changes of pole per sec. at 100 volts. With a 40-cm. spark coil, the primary of which consisted of only 43 turns of wire of 25-sq. mm. section, very powerful 38-cm. sparks were obtained at about one-half power, and a regular sheet of flame with greater power. Regard for the insulation prevented the limit being reached. This method is considered to be an advantageous one for obtaining and investigating high voltages more exactly. L. H. W.

878. *Effect of Metallic Cores in Coils.* **B. Eginitis.** (Comptes Rendus, 137. pp. 438–439, Aug. 24, 1903.)—The author investigates the influence of cores of iron, German silver, and copper. The effect is found to vary with the self-induction of the coil and the nature and the diam. of the core. The method employed is based upon the sensitiveness of the heating of the electrodes to variations in the self-induction in a discharge circuit [see Abstract No. 1430 (1903)], but is not described, only the above general results being summarised. L. H. W.

879. *Recent Progress in the Study of Magnetism.* **C. Maurain.** (Écl. Électr. 37. pp. 5–18, Oct. 3; and pp. 41–60, Oct. 10, 1903.)—A comprehensive general *résumé* of recent work on the subject of magnetism, with references to the original papers.

880. *Absolute Value of the Magnetic Elements on Jan.* 1, 1904, *at the Observatory of Val Joyeux.* **T. Moureaux.** (Comptes Rendus, 138. pp. 40–41, Jan. 4, 1904.)

881. *Application of the Röntgen Rays to Pearl Fishing.* **R. Dubois.** (Comptes Rendus, 138. pp. 301–302, Feb. 1, 1904.)—The author refers to the fact that it is easy, in spite of the non-transparency of the shell, to locate pearls in pearl oysters without opening the shell or injuring the mollusc in any way. The process is now employed in the Ceylon pearl fishery, saving much time and preventing the unnecessary waste and thinning of the beds, hitherto unavoidable. L. H. W.

882. *Law of Electrical Excitation for Certain Invertebrates.* **L. Lapicque** and **Mme. Lapicque.** (Comptes Rendus, 136. pp. 1147–1148, May 11, 1903.)—The authors have tested the law of excitation, enunciated by G. Weiss [see Abstract No. 1701 (1901)], for the muscles of certain marine invertebrates. When the duration of the current is from ½ to 2 sec. the formula holds good, but for periods less than ½ sec. the curve is not straight but is concave towards the base line. H. W. P. Y.

883. *Röntgen Rays in the Treatment of Superficial Cancer.* **H. E. Gamlen.** (Röntgen Ray, Archives, 8. pp. 111–119, Dec., 1903; and pp. 128–129, Jan., 1904.)—A review of the results of the application of the rays for this purpose, with photographs and details of cases, illustrating the changes produced by the treatment. L. H. W.

CHEMICAL PHYSICS AND ELECTRO-CHEMISTRY.

884. *Condensation Nuclei.* **C. T. R. Wilson.** (Nature, 68. pp. 548–550, Oct. 8, 1903.)—This is a criticism of a recent volume by C. Barus on "The Structure of the Nucleus, a Continuation of 'Experiments with Ionised Air.'" Wilson suggests that the cloud obtained when phosphorus is exposed to air does not contain free ions as Barus supposes, but that the correct view of the phenomenon is that of Schmid, who explained the cloud as due to the presence of the products of oxidation of phosphorus. [See also next two Abstracts.] J. J. S.

885. *Nuclei and Ions.* **C. Barus.** (Nature, 69. pp. 103–104, Dec. 3, 1903.)—A reply to the criticisms of C. T. R. Wilson [see preceding Abstract.] In any region of intense ionisation there must be a correspondingly marked tendency to synthesis. The nucleus is the stable result of this synthesis, and its structure depends on the chemical ingredients of the medium out of which the nucleus is made. The author contends that if nuclei are formed by the Röntgen rays at the anode and the kathode, they are liable to be different because the ingredients out of which they are compounded are different. Experiment shows the phosphorus nucleus to be a relatively persistent body, while the initial ionisation is to an equal degree characteristically fleeting. The case of water nuclei is in this respect almost the same. As there is no marked decrease of the number of nuclei while the ions all but go, so there is no contemporaneous increase of number; yet with phosphorus and water nuclei the activities of any generator for the simultaneous production of nuclei and ions seem to increase and decrease together. Electrification vanishes and leaves a nucleus behind, sometimes larger, sometimes smaller. The author never found nucleation and ionisation to vanish at the same rate. He considers the phosphorus nucleus the stable product of the initially ionised field. [See also next Abstract.] J. J. S.

886. *Nuclei and Ions.* **C. T. R. Wilson.** (Nature, 69. p. 104, Dec. 3, 1903.)—The author replies to the remarks of Barus [see preceding Abstract] and considers that the fact that the nuclei appeared distinct from the ions, persisting long after the ionisation disappeared, shows that Barus has not yet succeeded in observing condensation upon the ions, but only upon nuclei of another kind. To get condensation upon the ions the author found high supersaturation necessary, and to obtain this high supersaturation, exceedingly rapid expansion is required. The apparatus of Barus probably was not suitable for this purpose. In the author's experiments on condensation upon ions produced by Röntgen rays, nuclei more persistent than the ions were absent. J. J. S.

887. *Nuclei Produced by Shaking Liquids.* **C. Barus.** (Amer. Journ. Sci. 17. pp. 81–84, Jan., 1904.)—Particulars of the numbers of nuclei obtained by shaking different liquids are given. The curious result appears that the number of nuclei produced by a definite amount of shaking is least for water, about 5 times greater for dilute organic solutions in water, about 10 times greater for dilute inorganic solutions in water, and about 30 to 40 times

greater for dilute solutions of non-conductors like naphthalene and paraffine in benzol. It is difficult to conjecture the reason for this behaviour. Notes on coronas and axial colours are given by the author. The coronas in benzol are all normal. In the case of carbon disulphide vapour, coarse normal coronas also appear. With benzol vapour it is estimated that there were nearly 3,000,000 sulphur nuclei and nearly 900,000 punk nuclei per c.cm. in the laden air-currents entering the condensation chamber. J. J. S.

888. *Determination of Avidity by the Polarimetric Method.* **J. Walker.** (Zeitschr. Phys. Chem. 46. pp. 30–36, 1903. Dundee University College, July, 1903.)—The author has compared the relative strengths of certain organic acids by measuring the rotation produced by an optically active acid, by its sodium salt, and by a solution in which one equivalent each of the active and inactive acid compete for one equivalent of sodium hydroxide. The ratio of the differences between the last and the other two readings gives the distribution ratio of the two acids under observation, and results so obtained are found to agree closely with the values calculated from the square roots of the dissociation constants. Mandelic acid was compared with acetic and malonic acids, tartaric acid with acetic, chloracetic and malonic acids, and acid sodium tartrate with acid sodium malonate. The measurements were made with a Landolt-Lippich apparatus, with triple field, which could be read to 0·01°, and one-fourth of an equivalent of hydrochloric acid was added to solutions containing free acids alone, in order to reduce the degree of ionisation. W. H. Si.

889. *Vapour Densities of some Carbon Compounds; an attempt to Determine their Correct Molecular Weights.* **W. Ramsay** and **B. D. Steele.** (Phys. Soc., Proc. 18. pp. 543–572; Discussion, pp. 572–573, Dec., 1903.)—In extension of the work of D. Berthelot, the authors have carried out most accurate determinations of the density and compressibility of various vapours, since it should be possible from these to determine the molecular and atomic weights of the substances. The substances investigated were normal hexane, normal octane, di-isobutyl, benzene, toluene, ether and methyl alcohol, and special precautions, the details of which are given in the paper, were taken to ensure that the materials used should be obtained with the utmost degree of purity possible. The temperatures at which the experiments were carried out were approximately 100°, 115°, and 130°, the different temperatures being accurately determined. The density of oxygen was taken as standard of comparison, the weight of 1 litre of dry oxygen at 0° being taken as 1·42961, and the coefficient of expansion was determined in a special apparatus between the temperatures of 0° and 130° and found to be 0·0036694. The densities were determined by a modification of Gay-Lussac's method, the volumes of the vapour being determined by adjusting the surface of the mercury to a set of eight points of blue enamel glass. By this means the compressibilities could at the same time be determined; but for low pressures separate estimations of the compressibility were made with a special apparatus [see Abstract No. 191 (1903)]. The limit of accuracy of the determinations was about 1 part in 4,000. Having obtained the values of the density and compressibility, the value of the factor pv/mT (where $m =$ weight of substance taken) at zero pressure was determined graphically, so as to allow of the calculation of the molecular weights. The molecular weights of the substances thus obtained did not, however, agree with those calculated on the basis of $C = 12$, $O = 16$, $H = 1{\cdot}007$, the discrepancies being much greater

than could be explained by errors of experiment. As a result of their work, the authors point out that Avogadro's hypothesis does not hold for vapours, even under the ideal condition of zero pressure; and it must be concluded that the determination of the density of a vapour does not serve as a means of arriving at a conclusion regarding the accurate atomic weights of the elements present in a compound. A. F.

890. *Inclusion and Occlusion of Solvent by Crystals.* **T. W. Richards.** (Zeitschr. Phys. Chem. 46. pp. 189–196, 1903. Contribution from the Chemical Laboratory of Harvard College.)—The experiments here described show that many, if not all, crystals deposited from solutions contain included mother liquor, and that before the latter can be eliminated by pulverisation, the adsorption of water on the extended surface from a moist atmosphere begins to augment appreciably the weight of the substance. In the case of hydrated salts this adsorption cannot be overcome without a loss of water of crystallisation, so that such salts cannot be accurately weighed in the ordinary way. With anhydrous salts the elimination of adsorption is easy, but in order to remove included water, the cell walls enclosing it must be disintegrated; mechanical, thermal, and chemical methods for such disintegration are classified and applied to the preparation of pure materials. Other impurities will usually be enclosed with the solvent in the invisible cells, and these impurities must be borne in mind in processes of purification. It is suggested that these invisible but chemically perceptible impurities might often be used as a clue to the manner of growth of natural minerals, and hence to the mechanism of geo-physical processes. T. H. P.

891. *Isomerism and Optical Activity of Quinquevalent Nitrogen Compounds.* **H. O. Jones.** (Chem. Soc., Journ. 83. and 84. pp. 1400–1421, Jan., 1904.)—The author describes attempts to prepare isomeric quaternary compounds of the type $NR'R''R_2'''X$. The existence of such isomerism is theoretically possible for every configuration of the nitrogen atom, since the work of Pope and his collaborators has shown that the arrangement of radicles around a quinquevalent nitrogen atom is a stable one and causes optical activity. On the basis of Bischoff's pyramidal configuration, which offers the best explanation of the facts already known, two isomerides would be expected, of which one should be capable of existing in optically active forms. A number of compounds of the above type have now been prepared by the author, and their properties studied, but no sign of isomerism is observed. The compounds were converted into *d*-camphorsulphonate and *d*-bromocamphorsulphonate, and these salts then fractionally crystallised from hydroxyl-free solvents. Optical activity, dependent on an asymmetric nitrogen atom, would also be expected in α- and β- substituted pyridinium-compounds and in certain tetrahydroquinoline derivatives, but the author's attempts to resolve such compounds into isomerides have been unsuccessful. T. H. P.

892. *Polymorphic Transformation.* **Wallerant.** (Comptes Rendus, 138. pp. 59–60, Jan. 4, 1904.)—Pasteur has pointed out that the elements of symmetry of the different crystalline modifications of a polymorphous substance are usually somewhat similar, but it has hitherto been an open question whether there was any direct relationship between the successive forms. Direct evidence of this is afforded by the observation that when a

less symmetrical crystal is transformed into a more symmetrical crystal, *e.g.*, by rise of temperature, so that planes originally inclined become perpendicular, there is produced, before the transformation, a large number of hemitropic plates in which the plane of shearing or gliding is perpendicular to that which in the second modification becomes a new plane of symmetry. It would therefore appear that the particles of which the crystals are built up are the same in the two cases, but that they are rearranged in the one case symmetrically and in the other diagonally, in the one case with a plane of approximate symmetry and in the other with a true plane of symmetry.

T. M. L.

893. *Molecular Formulæ of Fused Salts as Determined by their Molecular Surface Energy.* **J. F. Bottomley.** (Chem. Soc., Journ. 83. and 84. pp. 1421–1425, Jan., 1904.)—The author has carried out an investigation of the molecular complexity of fused salts, by determining the rise in capillary tubes. The following are the results obtained :—

t	h	e	γ	$(Mv)^{2/3}$	k	x	M
Potassium nitrate I., $r = 0·02301$.							
338°	5·215	1·867	109·8	1571	0·471	9·55	101
406°	5·149	1·820	105·8	1539	—	—	—
Potassium nitrate II., $r = 0·02763$.							
349°	4·20	1·869	106·4	1521	0·554	7·49	101
414°	4·163	1·764	100·7	1485	—	—	—
Potassium nitrate III., $r = 0·02696$.							
341°	4·39	1·867	106·4	1551	0·485	9·145	101
407°	4·34	1·814	104·6	1519	—	—	—
Sodium nitrate I., $r = 0·02930$.							
339°	3·92	1·891	106·4	1374	0·500	8·73	85
405°	3·64	1·844	101·8	1308	—	—	—
Sodium nitrate II., $r = 0·02904$.							
329°	4·013	1·895	110·8	1398	0·381	13·13	85
405°	4·05	1·846	106·5	1369	—	—	—
Sodium nitrate III., $r = 0·02429$.							
344°	4·94	1·886	111·0	1403	0·453	10·17	85

In the above table M denotes molecular weight ; v, specific volume ; g, 981·1 ; e, density of fused salt ; x, coefficient of association ; h, rise in the capillary tube (centimetres) ; r, radius of capillary ; γ, surface-tension in dynes $= \frac{1}{2}$ ghr ; t, temperature in degrees C. From the above figures it is evident that the nitrates of sodium and potassium are composed of complex molecules ; the average value of k for the former is 0·445, and for the latter 0·503 ; these give values of molecular complexity equal to 10·68 and 8·73 respectively. These values, however, are to be considered as too high, but as affording proof of the complexity of the molecules.

A. F.

894. *Crystallographic and Molecular Symmetry of Position—Isomeric Benzene Derivatives.* **F. M. Jaeger.** (Konink. Akad. Wetensch. Amsterdam, Versl. 12. pp. 406–408, Jan. 21, 1904. Translated from Versl. van de gewone vergadering der Wis- en Natuurkundige Afdeeling, Dec. 19, 1903.)—In order to discover a relation between crystalline form and molecular structure, the author has examined crystallographically the six isomeric tribromotoluenes, which have a high molecular weight and but slightly different chemical properties, so that variations in the crystalline form are practically only caused by the different relative positions of the groups of atoms in the molecule. Four of these compounds are monoclinic, one rhombic, and one tetragonal, the last two having the three bromine atoms in the vicinal position. Two of the monoclinic forms ($CH_3 : Br_3 = 1:2:3:5$ and $1:2:4:6$) exhibit isomorphism bordering on identity, and form mixed crystals in all proportions; the similarity in the structure of their chemical molecules becomes more evident when the analogy, which has been noticed in certain cases, between the methyl group and the bromine atom, is borne in mind. The densities of the four monoclinic forms do not differ greatly, but that of the rhombic isomeride is smaller and that of the tetragonal compound smaller still, so that a higher symmetry of form is accompanied by a less density. T. H. P.

895. *Quantitative Examination of Baeyer's Tension Theory.* **A. F. Holleman** and **G. L. Voerman.** (Konink. Akad. Wetensch. Amsterdam, Versl. 12. pp. 410–412, Jan. 21, 1904. Translated from Versl. van de gewone vergadering der Wis- en Natuurkundige Afdeeling. Groningen, Lab. Univers., Nov., 1903.)—In order to introduce quantitative relations into Baeyer's tension theory of ring structure, the authors have investigated the relative stability of the anhydrides of the dibasic acids of the normal saturated series. The ease with which these anhydrides reabsorb water and pass into the corresponding acids must depend on the degree of tension in the ring contained in the anhydrides, and the velocity of conversion of the anhydrides into acids may be taken as a measure of this tension. Dilute solutions were employed, so that the change may be represented by the equation for monomolecular reactions. Only with succinic and glutaric anhydrides were satisfactory determinations possible, the values of $K = 1/(t_2 - t_1) \times \log (C_1/C_2)$ (t in minutes and C in gramme-mols. per litre) at 25° being 0·1683 and 0·1708 respectively; the five-ring is hence somewhat more stable than the six-ring. The higher anhydrides are not sufficiently soluble in water to give accurate measurements. T. H. P.

896. *Geological Association of Iron and Phosphorus. Dephosphoration of Iron Ores in Natural Metallurgy.* **L. de Launay.** (Comptes Rendus, 138. pp. 225–227, Jan. 25, 1904.)—Traces of phosphorus are usually associated with iron, even in the case of meteorites, but it is found in only small quantities in basic segregated minerals, such as magnetite or titanomagnetite, and in minerals in which secondary changes have taken place, whether the original mineral were pyrites or siderose. The two purest ores are therefore those formed by the natural rusting or artificial roasting of pyrites, and those which, having been formed by precipitation in calcareous rocks, have passed through the stage of (ferrous) carbonate before being converted into (ferric) oxide or hydrate. The former contain sulphur, and the latter are therefore the most valuable ores for the Bessemer process. In the weathering of more or less alkaline silicates, the phosphorus usually becomes segregated from the iron and appears in the form of apatite; this change appears to have gone on to an extraordinarily large extent, the *average* thickness of the strata affected being 1,500 m., and containing 70 m. of ferric oxide and 6 or 7 m. of apatite

which have been dissolved and separately precipitated. The change is probably brought about by air charged with oxygen and carbonic acid, the latter dissolving the iron and the phosphate together, whilst the former precipitates the iron only. T. M. L.

897. *Preparation and Compression of Pure Gases for Experimental Work.* **R. S. Hutton** and **J. E. Petavel.** (Soc. Chem. Ind., Journ. 23. pp. 87–93; Discussion, p. 93, Feb. 15, 1904. Paper read before the meeting of the Manchester Section, Jan. 8, 1904.)—The authors describe methods and apparatus for preparing a number of gases on a large scale, using ordinary laboratory apparatus. The apparatus has been devised for gas preparation and purification at a rate of about 1 litre per sec. (130 cub. ft. per hour). Hydrogen was made from zinc and arsenic-free sulphuric acid. The most convenient method for nitrogen was found to be by passing air and ammonia over red-hot copper turnings. The ammonia had to be in excess, about twice the theoretical quantity, otherwise oxides of nitrogen were produced. The nitrogen contained about 4 per cent. hydrogen. Carbon monoxide was obtained from commercial formic acid and concentrated sulphuric acid, the temperature of the bolt-head containing the mixture being kept at from 150°–170° C. Ethylene was made from methylated spirit and sulphuric acid; in this case it was essential that the sulphuric acid should be kept between 160° and 165° C., since, even at a few degrees above this, carbonisation commences, accompanied by the production of sulphur dioxide and carbon monoxide. At a temperature below 160° C. the yield falls very rapidly, almost all the alcohol being transformed into ether. The yield was about 50 per cent. Reference is also made to the various commercial processes for making the above gases, and also oxygen, nitrous oxide, carbon dioxide, sulphur dioxide, and ammonia. The authors finally describe the apparatus they use for compression and storage of the gases, for the details of which it will be necessary to consult the original paper. T. S. P.

898. *Double Linkings in the Nuclei containing the Asymmetric Carbon Atom and the Rotatory Power of Cyclic Molecules.* **A. Haller.** (Comptes Rendus, 136. pp. 1222–1226, May 25, 1903.)—The author's investigations indicate that the rotatory power of certain molecules is increased: (1) By the fixation, by means of a single linking, of unsaturated radicles on to an optically active nucleus; (2) by the formation of double linkings in nuclei, without either substitution or addition occurring; (3) by combining, *viâ* double bonds, aliphatic or aromatic radicles to the active nucleus; (4) by a tautomeric change similar to that occurring with β-ketonic molecules which change into the enolic form and so assume an unsaturated character; (5) by combination of active alcohols with unsaturated acids or of unsaturated alcohols with active acids. T. H. P.

899. *Oceanic Salt Deposits.* XXXII. **J. H. van't Hoff** and **W. Meyerhoffer.** (Preuss. Akad. Wiss. Berlin, Sitz. Ber. 32. pp. 678–684, June 25, 1903.)—This article is entitled "Upper Limits for the Existence of Schönite, Magnesium Sulphate, Hepta- and Hexa-hydrate, Astrakanite, Leonite, and Kainite in presence of Rock Salt." It has already been shown that langbeinite, loeweite, and vanthoffite cannot be formed below 37°, 43°, and 46° respectively, and that during the formation of oceanic salt deposits the temperature cannot have been lower than these temperatures. The present paper deals with those cases in which there is an upper limit for the

existence of minerals occurring in the salt-beds, and a table is given showing at what temperatures these minerals break up, both with and without common salt as a solid phase :—

Mineral.	With Salt.	Without Salt.	Product.
Glauber's salt, $Na_2SO_4 . 10H_2O$	18°	32½°	Thenardite, Na_2SO_4
Schönite, $K_2Mg(SO_4)_2 . 6H_2O$	26°	47½°	Leonite, $K_2Mg(SO_4)_2 . 4H_2O$
Reichardtite, $MgSO_4$, $7H_2O$	31°	48°	Hexahydrate, $MgSO_4 . 6H_2O$
Hexahydrate, $MgSO_4$, $6H_2O$	35½°	67½°	Kieserite, $MgSO_4 . H_2O$
Astrakanite, $Na_2Mg(SO_4)_2 . 4H_2O$	59°	71°	Loeweite, $Na_4Mg_2(SO_4)_4$, $5H_2O$
Leonite, $K_2Mg(SO_4)_2 . 4H_2O$	61½°	89°	Langbeinite, $K_2Mg_2(SO_4)_3$
Kainite, $MgSO_4$, KCl, $3H_2O$	83°	85°	Hardsalt, $MgSO_4$, KCl, H_2O

Thenardite appears to be stable down to 16°.

These values represent approximately the maximum temperatures at which the minerals can have been deposited naturally, though saturation with salt does not absolutely reproduce the natural conditions. As hardsalt at one end of the series and Glauber's salt at the other end of the series are found in the natural deposits, the conclusion appears to be justified that the temperature at which the salt-beds were deposited must have varied from 83° to 18°, *i.e.*, from near the boiling-point of water practically down to the present atmospheric temperatures. No indication has been obtained of the presence of minerals requiring a higher temperature than 83° for their formation. T. M. L.

900. *Formation of Oceanic Salt Deposits.* XXXIII. *Separation of the Calcium Salts, Anhydrite, Glauberite, Syngenite, and Polyhalite at* 25°. **J. H. van't Hoff** and **F. Farup.** (Preuss. Akad. Wiss. Berlin, Sitz. Ber. 46. pp. 1000–1010, Nov. 11, 1903.)—The following table shows the solubility of the above-mentioned calcium salts in the most important salt solutions :—

Solid phases, NaCl with—	Per 1,000 H_2O in Molecules.					
	Na_2Cl_2.	K_2Cl_2.	$MgCl_2$.	$MgSO_4$	Na_2SO_4.	$CaSO_4$.
I. Three calcium salts.						
(*a*) Alone	50	6	...	...	4	0·4
(*b*) $MgSO_4 . 7H_2O$	13·5	5	36	20	...	0·8
II. Glauberite, Anhydrite.						
(*c*) Alone	54	...	...	...	3	0·25
(*d*) $MgSO_4 . 7H_2O$	14·5	...	37	20	...	...
III. Glauberite, Syngenite.						
(*e*) Na_2SO_4	47	5·5	...	...	14	...
(*f*) Astr., $MgSO_4 . 7H_2O$	14·5	5·5	32·5	23	...	...
(*g*) Astr., Na_2SO_4	25	8·5	16·5	...	22	...
IV. Syngenite, Anhydrite.						
(*h*) KCl	46	19·5	...	...	...	0·7
(*g*) Kainite, KCl	4·5	7	62·5	7·5	...	0·8
(*j*) Kainite, $MgSO_4 . 7H_2O$	7	6·5	52	17·5	...	0·8

T. M. L.

901. *Constitution of the Double-salts of Antimony Pentachloride, and Chromium Trichloride.* **P. Pfeiffer.** (Zeitschr. Anorg. Chem. 36. 3. pp. 349–354, Sept. 16, 1903. Chem. Universitäts Laboratorium, Zürich, July, 1903.)—According to R. F. Weinland and C. Feige (Ber. deutsch. chem.

Ges. 36. 244. 1903) the constitutions of the two salts $CrCl_3 . 3SbCl_5 . 13H_2O$ (violet) and $CrCl_3 . SbCl_5 . 10H_2O$ (green) are expressed by the formulæ, $Cr(SbCl_6)_3 . 13H_2O$ and $Cr(SbCl_8) . 10H_2O$, *i.e.*, they are the chromium salts of the halogenic complex acids $H(SbCl_6)$ and $H_3(SbCl_8)$. The author shows, however, that on removing the antimony from solutions of these salts by means of H_2S, the resulting solutions of chromium chloride are not the same (as would be the case if the chromium existed in each salt as positive ion, according to the formulæ of Weinland and Feige), the violet salt giving a violet, and the green salt a green, solution. In analogy with the researches of Werner and Gubser (Ber. deutsch. chem. Ges. 34. 1579. 1901) on the green and bluish-grey varieties of chromium trichloride, the author ascribes to the present compounds the following constitutions: Violet salt, $[Cr(OH_2)_6][SbCl_6]_3 + 7H_2O$; green salt, $[Cr(OH_2)_4Cl_2][SbCl_6] + 6H_2O$, *i.e.*, both salts are derived from one and the same complex chlorantimonic acid, $HSbCl_6$, but the violet salt is derived from the complex hexaquo chromium base $[Cr(OH_2)_6][OH]_3$, whilst the green compound is a salt of the complex tetraquo dichloro chromium base $[Cr(OH_2)_4Cl_2][OH]$. F. G. D.

902. *Oxalates of Trivalent Thallium.* **W. O. Rabe** and **H. Steinmetz.** (Zeitschr. Anorg. Chem. 37. 1. pp. 88–112, Oct. 27, 1903. Chem. Laboratorium des kgl. mineralogischen Instituts, München.)—On account of the great variation in the chemical relationships of thallium, the author has studied the oxalates of trivalent thallium, and finds that in some of its properties distinct analogies exist to the behaviour of the earths scandium, yttrium, and lanthanum, although in some cases differences, *e.g.*, the readiness of formation of acid oxalates, are met with. This behaviour, however, brings thallium into line with aluminium, iron, and chromium. On the whole, the double salts of trivalent thallium exhibit very frequently the empirical composition of complex compounds in the sense used by Werner. These, however, do not appear to yield stable complex ions in solution. A table of the double salts of trivalent thallium is appended. A. F.

903. *The First Anhydrous Modification of Calcium Sulphate.* **P. Rohland.** (Zeitschr. Anorg. Chem. 36. 3. pp. 332–339, Sept. 16, 1903. I. Chem. Institut der technischen Hochschule, Stuttgart.)—The author refers to the confusion which has arisen owing to the introduction of the term "so-called dead-burnt gypsum." Technically, the anhydrous modification, obtained by heating for some time to above 130°, is called "dead burnt," and was designated by the author as the first anhydrous modification of calcium sulphate.

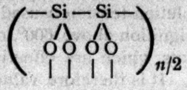
This form can undergo hydration, but cannot be employed for forming casts. Although no chemical differences have been observed between the first and the second anhydrous modification (Estrich gypsum), differences in the physico-chemical behaviour exist. More especially is this the case with regard to its velocity of hydration under the influence of sodium chloride and potassium dichromate. According to the author, three theories can be put forward in explanation of the behaviour of the first anhydrous modification. The first has reference only to the setting of dead-burnt gypsum under the influence of potassium sulphate, and the cause is to be sought in the formation of a double potassium calcium salt. Secondly, there is the "nucleus" theory of Ostwald, but in this case it would require to be assumed that not only analogous salts (sulphates) could introduce nuclei, but also nitrates and potassium dichromate. The third theory, put forward by the author, regards the processes of hydration and hardening as taking place spontaneously, and as being affected to a great extent by positive and negative catalytic agents. Attention is also called to the parallelism between the acceleration of hydration and the increasing of the solution tension or between the retardation and the diminution of the solution tension caused by catalysers. True dead-burnt gypsum, obtained by ignition above 600°, cannot be caused to hydrate by any of the catalytic agents which are effective in the case of the "so-called" dead-burnt gypsum. It is therefore valueless in the arts. [See also Abstracts Nos. 501 and 1487 (1903).] A. F.

904. *Internal Friction of Colloidal Solutions.* **W. S. Sadikoff.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 35. No. 9. pp. 1004–1005, 1903. Paper read before the Russian Physico-Chemical Society (Chemistry Section), Nov. 6–19, 1903.)—The present paper is a continuation of a previous investigation into the problem of the velocity of coagulation of colloidal solutions. The author here investigates whether such bodies as influence the velocity of coagulation exert an influence also on the coefficient of internal friction. In the case of glutine there is no direct connection in this respect. Any bodies which lower the coefficient of internal friction of water, however, prove also to lower the coefficient of internal friction of glutine solutions, and inversely. Any coagulating colloidal solutions only show a constant coefficient of internal friction at temperatures far removed from the temperature of coagulation; the further the temperature is distant from the temperature of coagulation, the more constant will be the coefficient of internal friction; even in the case of the temperature being constant, the coefficient of internal friction is shown to increase progressively. To obtain comparative data, the author investigated solutions of caseine in a 1 per cent. solution of weak NaOH. Diluted solutions, up to $\frac{1}{4}$ normal, all lower the coefficient of internal friction; the higher the concentration of the solution, the greater the increase in the coefficient of internal friction of the mixture. A. G.

905. *Colours of Iodine Solutions.* **A. Lachman.** (Chem. News, 88. pp. 307–309, Dec. 24, 1903.)—By using pure solvents, solutions of iodine are found to have only two colours, violet and brown, and from experiments with a very considerable number of compounds, the author concludes that saturated solvents give violet solutions, while those that are unsaturated in character give brown ones, an addition product probably being formed in the latter case. The first class consists of hydrocarbons, their chlorides and bromides, carbon bisulphide, and nitro-compounds, the second comprising alcohols, ethers, ketones, acids and esters, nitriles and nitrilo-bases, alkyl and other iodides, and bivalent sulphur compounds. The view that the brown solutions contain some addition product is supported by the fact that heat tends to change brown solutions to violet, whilst cold converts violet into brown solutions; attempts are being made to isolate the addition product. W. H. Si.

906. *Constitution of Certain Silicates.* **C. Simmonds.** (Chem. Soc., Journ. 83. and 84. pp. 1449–1469, Jan., 1904.)—The structural formulæ usually given to the silicates do not explain their behaviour when reduced in a current of hydrogen at a red heat. In some cases the reduction is complete and in others only partial, whilst some silicates do not give up any oxygen under these conditions. The following conclusions are drawn by the author: (1) The silicon atoms are in direct combination with each other and are not joined by means of oxygen. (2) To the chain of Si_n atoms thus

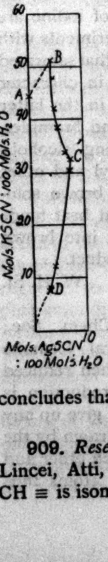
formed, the oxygen corresponding with $(SiO_2)_n$ is attached, giving the mode of grouping denoted by—



(3) The oxygen valencies here shown unappropriated are those by which the basic oxides, PbO, CuO, &c., are attached to the silicate molecule. The free valencies of the end silicon atoms of the chain may possibly be united so as to form a closed ring of silicon atoms. These views are applied to various natural silicates. T. H. P.

907. *Fluorochlorides, Fluorobromides, and Fluoroiodides of the Alkaline-earth Metals.* **E. Defacqz.** (Comptes Rendus, 138. pp. 197–199, Jan. 25, 1904.)—Barium fluorochloride, prepared by heating a mixture of manganese fluoride (10 parts) and barium chloride (40 parts) at 1,000° during two hours, is a well-crystallised compound of density 4·51 at 18° C. It is insoluble and is not decomposed by hot and cold alcohol; cold water does not appear to have much action, but at the end of two months the solution contains 14·5 of the 18·53 parts of chlorine; hot water rapidly renders the crystals opaque, and after long boiling the fluorochloride is converted completely into a suspended powder of barium fluoride. A similar decomposition is produced by acetic, hydrochloric, and nitric acids; sulphuric acid yields barium sulphate, hydrofluoric and hydrochloric acids. The fluorobromide, prepared by a similar method, has density 4·96, and the fluoroiodide, 5·21. They resemble the fluorochloride, but are more easily decomposed. T. M. L.

908. *Thiocyanates of Silver and Potassium and their Solubility.* **H. W. Foote.** (Zeitschr. Phys. Chem. 46. pp. 79–86, 1903. Sheffield Chemical Laboratory, New Haven, Conn., Feb., 1903.)—The author has investigated the solubility relations of potassium and silver thiocyanates for the purpose of ascertaining what double salts are formed, and the conditions of their stability. The analysis was carried out by precipitating the silver thiocyanate by addition of water, and then titrating the filtrate with standard silver nitrate. The solubility isothermal for 25° is given in the Fig. *A* represents the solubility of pure potassium thiocyanate (44·86 gm. mol. in 100 gm. mol. of water); at *B* the solid phases are KCNS and 2KCNS, AgCNS; at *C* the solid phases are 2KCNS, AgCNS and KCNS, AgCNS; and at *D*, KCNS, AgCNS and AgCNS. The double salt 3KCNS, AgCNS can be obtained by dissolving 30 gm. of silver thiocyanate and 100 gm. of potassium thiocyanate in a small quantity of water. This salt breaks down into potassium thiocyanate and the double salt 2KCNS, AgCNS, as was shown by solubility experiments. The author did not succeed in finding a transition-point for the double salt 3KCNS, AgCNS, but from measurements which he made concludes that it can be stable only at a low temperature, if at all. A. F.



909. *Researches on Solid Solutions and on Isomorphism.* **M. Padoa.** (Accad. Lincei, Atti, 12. pp. 391–397, May 17, 1903.)—It is known that the group CH ≡ is isomorphogenous with N ≡ in many mononitrogenous compounds.

With one exception, polynitrogenous compounds have not been experimentally compared with the compounds derived from them by replacing the nitrogen by CH ≡ groups. The author finds that dimethylpyrazine (though normal in benzene solution) gives distinctly high values for the molecular weight in *p*-xylene, so that we thus have evidence of the formation of solid solutions, and therefore of the isomorphism of the two compounds under examination. Nevertheless, we cannot assert that there is a general tendency to form solid solutions between heterocyclic polynitrogenous compounds and the corresponding homocyclic bodies, since quinazoline, phthalazine, and quinonaline (all of the molecular weight 130) give only slightly, if at all, high values for the molecular weight in naphthalene, and they are quite normal in diphenyl. Similarly, phenazine and naphthoquinonaline give quite normal molecular weights in phenanthrene. [See also Abstract No. 505 (1903).] D. H. J.

910. *Theory of Capillarity and Colloidal Solutions.* **F. G. Donnan.** (Zeitschr. Phys. Chem. 46. pp. 197–212, 1903. Royal College of Science, Dublin, July, 1903.)—The author fully considers the possibility of negative interfacial tension from the point of view of the simple Laplace-Gauss theory of capillary forces. In certain cases the spontaneous formation of fine-grained heterogeneous systems can be predicted from mathematical reasonings. Colloidal solutions are regarded as extremely fine-grained two-phase systems, and their origin may be due to the interaction of capillary forces. This explanation the author considers to be better than the favourite hypothesis of large molecules. F. S.

911. *Crystallisation in Binary Systems.* **W. D. Bancroft.** (Zeitschr. Phys. Chem. 46. pp. 87–88, 1903. Cornell University, Ithaca.)—The author shows how, by a slight modification of the diagram for a two-component melt allowed to solidify, it may be used to determine the nature and relative amounts of the phases formed (provided no solid solutions occur) when such a melt is allowed to cool slowly, and the crystals are removed as they are formed. The diagram obtained also applies to the case of complete hysteresis, as, if the solid phases change very slowly in comparison with the rate of cooling, the final result will be the same as though the crystals were removed as soon as they were formed. T. H. P.

912. *Solubilities of Sparingly Soluble Substances.* **W. Böttger.** (Zeitschr. Phys. Chem. 46. pp. 521–619, 1903.)—On account of the fact that there is no certainty as to the measure in which the solubility of sparingly soluble substances is diminished by addition of a salt with the same ion, the author considers that there is no reason for giving the preference to electrometric determinations of solubility; and in this investigation only conductivity methods are employed. The preparation of the saturated solution and the measurement of its conductivity were carried out in a modified Kohlrausch vessel. Great care was taken in the purification of the salts used, and the water employed had a conductivity of about 1×10^{-6}. As the size of the solid particles was not directly measured, the author gives details of preparation and treatment of the solid phase, and assumes that under similar conditions the mean state of subdivision will be nearly the same. The author discusses the values of the ion mobilities, and accepts and employs the following (for 20°) : $\mathrm{Ag}^{\cdot}$ 57·0 ; $\mathrm{H}^{\cdot}$ 340 ; $\mathrm{Tl}^{\cdot}$ 68·8 ; $\frac{1}{2}\mathrm{Ca}^{\cdot\cdot}$ 54·5 ; $\frac{1}{2}\mathrm{Pb}^{\cdot\cdot}$ 64·5 ; Cl' 68·5 ;

Br' 70·1 ; I' 69·2 ; CNS' 59·1 ; CN' 58·5 ; $Ag(CN)_2'$ 45·4 ; BrO_3' 48·3 ; IO_3' 35·5 ; OH' 180·2 ; $\frac{1}{2}CO_3''$ 63 ; $\frac{1}{2}C_2O_4''$ 66·7 ; $\frac{1}{2}SO_4''$ 71·4 ; $\frac{1}{3}PO_4'''$ 75. The following table gives the results found: κ_s = conductivity of solution, κ_ω = conductivity of water.

Salt.	Temperature.	$\kappa_s - \kappa_\omega \times 10^6$	Ion Concentration in Equivalents in 1 litre.	Total Concentration.
$CaSO_4$	19·94°	19·38	$1·56_3 \times 10^{-2}$	$2·99 \times 10^{-2}$
$AgCl$	19·95	1·33	$1·06 \times 10^{-5}$	$1·06 \times 10^{-5}$
$AgBr$	19·96	0·057	$4·5 \times 10^{-7}$	$4·5 \times 10^{-7}$
$AgCNS$	19·96	0·096	$8·2_7 \times 10^{-7}$	$8·2_7 \times 10^{-7}$
$Ag.Ag(CN)_2$	19·96	$0·15_4$	$1·5_0 \times 10^{-6}$	$1·5_0 \times 10^{-6}$
$AgCN$	19·96	0·19	$1·6_4 \times 10^{-6}$	$1·6_4 \times 10^{-6}$
$AgBrO_3$	19·94	663·9	$6·30_5 \times 10^{-3}$	$6·7 \times 10^{-3}$
$AgIO_3$	19·95	14·05	$1·51_9 \times 10^{-4}$	$1·54 \times 10^{-4}$
Ag_2O	19·96	29·27	$1·23_4 \times 10^{-4}$	$1·84_7 \times 10^{-4}$
Ag_2O	24·94	35·98	$1·88_9 \times 10^{-4}$	$2·16 \times 10^{-4}$
$Ag_2C_2O_4$	19·96	28·76	$2·32_6 \times 10^{-4}$	$2·40_4 \times 10^{-4}$
Ag_3PO_4	19·46	6·10	$4·5_2 \times 10^{-5}$	$4·6_1 \times 10^{-5}$
$TlCl$	19·96	168·0	$1·22_4 \times 10^{-2}$	$1·36 \times 10^{-2}$
$TlBr$	20·06	220·9	$1·59_0 \times 10^{-3}$	$1·64^4 \times 10^{-3}$
TlI	20·15	26·18	$1·89_8 \times 10^{-4}$	$1·92^2 \times 10^{-4}$
$TlCNS$	19·94	140·0	$1·09_4 \times 10^{-2}$	$1·20_3 \times 10^{-2}$
$TlBrO_3$	19·94	108·0	$9·22 \times 10^{-3}$	$9·94_8 \times 10^{-3}$
$TlIO_3$	19·95	154·2	$1·47_9 \times 10^{-3}$	$1·52_4 \times 10^{-3}$
$Tl_2C_2O_4$	19·96	534·4	$3·94_4 \times 10^{-2}$	$6·35_6 \times 10^{-2}$
Tl_2S	19·96	216·0	...	$0·86 \times 10^{-3}$
$PbCl_2$	19·95	5354	$Pb^{\cdot\cdot}$ 0·0168 $PbCl^{\cdot}$ 0·0109 Cl' 0·0444 $PbCl_2$ 0·00127	$6·92 \times 10^{-2}$
$PbBr_2$	19·96	3692	$Pb^{\cdot\cdot}$ 0·0106 $PbBr^{\cdot}$ 0·0110 Br' 0·0322 $PbBr_2$ 0·00114	$4·54_9 \times 10^{-2}$
PbI_2	20·10	338·4	$2·53 \times 10^{-3}$	$2·61 \times 10^{-3}$
$Pb(CNS)_2$	19·96	2640	$Pb^{\cdot\cdot}$ 0·0121 $PbCNS^{\cdot}$ 0·00727 CNS' 0·00315 $Pb(CNS)_2$ 0·000615	$2·78_8 \times 10^{-2}$
$Pb(BrO_3)_2$	19·94	4635	$4·11_1 \times 10^{-2}$	$5·78 \times 10^{-2}$
$Pb(IO_3)_2$	19·95	6·5	$6·5_0 \times 10^{-5}$	$6·57 \times 10^{-5}$
PbO	19·96	25·5	$1·04 \times 10^{-4}$	$1·53 \times 10^{-4}$
PbO	19·96	29·94	$1·22 \times 10^{-4}$	$1·85 \times 10^{-4}$
PbO	19·96	19·7	$0·80_5 \times 10^{-4}$	$1·15 \times 10^{-4}$
$PbCO_3$	19·96	1·02	$8·0 \times 10^{-6}$	$8·3 \times 10^{-6}$
$PbCO_3$	19·96	$1·5_4$	$1·2_1 \times 10^{-5}$	$1·2_6 \times 10^{-5}$
$PbCO_3$	19·96	1·61	$1·2_6 \times 10^{-5}$	$1·3_1 \times 10^{-5}$
PbC_2O_4	19·96	1·52	$1·16_3 \times 10^{-5}$	$1·22 \times 10^{-5}$
$PbSO_4$	19·95	34·76	$2·55_8 \times 10^{-4}$	$2·77 \times 10^{-4}$
$PbSO_4$	19·94	35·05	$2·57_9 \times 10^{-4}$	$2·79 \times 10^{-4}$
$PbSO_4$	24·95	40·19	$2·65_8 \times 10^{-4}$	$2·88 \times 10^{-4}$
$PbSO_4$	24·95	40·63	$2·68_6 \times 10^{-4}$	$2·91 \times 10^{-4}$
$Pb_3(PO_4)_2$	19·95	0·14	$9·8 \times 10^{-7}$	$1·0 \times 10^{-6}$

The author has also applied the determinations of solubility to the discussion of the conditions for the separation of salts by fractional precipitation.

A. F.

913. *Absorption Compounds.* **J. M. van Bemmelen.** (Zeitschr. Anorg. Chem. 36. 3. pp. 380–400, Sept. 16, 1903. Anorg. chem. Lab. der Universität, Leiden, June, 1903.)—In this paper the absorption of $Ba(OH)_2$, $BaCl_2$, and acids by colloidal ferric hydrate and the absorption of $Ba(OH)_2$ by colloidal silicic acid are studied. In the case of ferric hydrate and a strong mineral acid the colloidal absorption is followed by solution, due to true chemical interaction between the ferric hydrate and the acid. In the case of silicic acid and baryta the absorption is followed by the appearance of a definite crystalline compound, $BaSiO_3 . 6H_2O$. These instances serve very clearly to emphasise the sharp distinction between the absorption of a substance from a solution by a colloidal body and true chemical interaction according to definite proportions. [See also Abstract No. 1505 (1903).]

F. G. D.

914. *Behaviour of Tellurium Compounds on Heating with Ammonium Chloride.* **A. Gutbier** and **F. Flury.** (Zeitschr. Anorg. Chem. 37. 1. pp. 152–157, Oct. 27, 1903. Chem. Lab. der kgl. Universität, Erlangen.)—Tellurium compounds behave in a characteristic manner when heated with ammonium chloride. The mixture becomes yellow and then orange, whilst a white sublimate is also produced; shortly after the mixture blackens and a yellow sublimate appears, which on cautious heating becomes black. The behaviour of the tellurium compounds is very similar to that of ammonium platinichloride when heated, but appears to be somewhat more complex.

T. M. L.

915. *Solvent Power of Salt Solutions for Ammonia, as Determined by Measurements of the Partial Pressure.* II. **H. Riesenfeld.** (Zeitschr. Phys. Chem. 45. pp. 461–464, Nov. 3, 1903.)—The following table shows the lowering of the solubility of ammonia per equivalent of added salt at 25° (Abegg and Riesenfeld), 35° (Riesenfeld), and 60° (Konowalow):—

	25°.	35°.	60°.
$\frac{1}{2}Na_2CO_3$	0·29	0·16	0·18
$\frac{1}{2}K_2CO_3$	0·30	0·20	0·23
KOH	0·26	0·26	0·24
NaOH	0·21	0·21	0·20
KCl	0·14	0·15	0·11
NaCl	0·18	0·07	0·07
LiCl	0·04	— 0·18	— 0·05
KNO_3	0·15	0·16	0·13
$CH_3 \cdot CO_2K$	0.21	0·20	0·19
$\frac{1}{2}(CO_2K)_2$	0·21	0·20	0·18

The temperature-coefficient is only large in the case of the two carbonates and sodium and lithium chlorides, and in the other cases there is probably little specific chemical action. Potassium chloride may perhaps interact like sodium and lithium chlorides, but with only a small evolution of heat. The temperature-coefficient, though small, appears normal in the table giving the differences between 25° and 35°:—

	Cl.	$\frac{1}{2}CO_3$.
K	0·01	0·10
Na	0·06	0·13
Li	0·22	...

[See also Abstract No. 1744 (1902).]

T. M. L.

916. *Solubility of some Sparingly Soluble Silver Salts.* **R. Abegg** and **A. J. Cox.** (Zeitschr. Phys. Chem. 46. pp. 1–12, 1903. Physik.-chem. Abteilung des chem. Universitäts-Laboratoriums, Breslau).—The authors have determined the solubility of silver borate, chromate, carbonate, oxide, and thiocyanate, chiefly by means of electromotive force measurements. The results obtained are as follows, the numbers giving the solubility in terms of gm.-atoms silver per litre: Silver borate, ca. 6×10^{-3}; chromate, ca. $1{\cdot}2 \times 10^{-4}$; carbonate, ca. $1{\cdot}2 \times 10^{-4}$; oxide, $1{\cdot}8 \times 10^{-4}$ (from measurements of complex ammonia ion formation), ca. 7×10^{-4} (from e.m.f.); thiocyanate, $1{\cdot}25 \times 10^{-6}$ (from complex ammonia ion formation). The following silver electrode potentials in volts were found, the depolariser being the sparingly soluble silver salt in question, and the concentration of the solutions being such that they contained 1/10 of the formula weight of dissolved substance in the litre: KBr, $-0{\cdot}133$; KCNS, $-0{\cdot}127$; KCl, $+0{\cdot}015$; $1/2Ba(OH)_2$, $+0{\cdot}111$; $1/2Na_2CO_3$, $+0{\cdot}226$; $1/10\ K_2CrO_4$, $+0{\cdot}227$; $1/2Na_2B_4O_7$, $+0{\cdot}343$. A list of the solubilities of silver salts so far as known is also given. A. F.

917. *Complex Zirconium Compounds.* **A. Mandl.** (Zeitschr. Anorg. Chem. 37. 2. pp. 252–302, Nov. 6, 1903. Deutsche technische Hochschule, Prag, July, 1903.)—Examination of the behaviour of zirconium salts towards salts of the carboxylic acids shows that a condition for the formation of double salts and complex compounds is the presence of at least two carboxyl-groups in neighbouring positions. With the only slightly dissociated hydroxy-carboxylic acids, however, either no double salts are formed or only highly complex ones; the author considers that this is due to the union of the zirconium with the hydroxyl-groups, as these salts all have an acid reaction. Other hydroxylic compounds exhibit similar behaviour. T. H. P.

918. *Hydrates of Molybdic Acid.* **A. Rosenheim** and **I. Davidsohn.** (Zeitschr. Anorg. Chem. 37. 2. pp. 314–325, Nov. 6, 1903. Wissenschaftlich-chem. Laboratorium, Berlin, Sept. 22, 1903.)—The results of the authors' investigations lead to the following conclusions: (1) Yellow molybdic acid separates almost quantitatively from an acidified solution of alkali molybdate under certain conditions of concentration; it only forms slowly, however, because it is a polymeride of the simple dihydrate, $MoO_3, 2H_2O$. In solution it behaves as a strong electrolyte, the acid present being probably $H_2Mo_8O_{25}$. (2) The dihydrate is decomposed by alkali or by methyl alcohol, which yields dimethyl molybdate, a compound hydrolysed in aqueous solution into methyl alcohol and molybdic acid hydrate; the latter is considerably less dissociated in aqueous solution than the dihydrate. (3) When heated at 40–50°, aqueous solutions of the dihydrate yield a monohydrate of α-molybdic acid, whilst at 60–70° a monohydrate of β-molybdic acid is obtained; the transformation temperature could not be determined because the change is one of polymerisation. T. H. P.

919. *Action of Titanic Anhydride on Sodium Carbonate.* **D. P. Smith.** (Zeitschr. Anorg. Chem. 37. 2. pp. 332–336, Nov. 6, 1903. Laboratorium für anorganische Chemie, Göttingen.)—When sodium carbonate and titanic anhydride are fused together, an equilibrium is arrived at, depending on the pressure of carbon dioxide on the mass and expressed by the following equation, $Na_2CO_3 + TiO_2 \rightleftharpoons Na_2TiO_3 + CO_2$; when the mass is allowed to cool and crystallise, no evolution of carbon dioxide occurs, so that the quantity of the free gas in the molten mixture must be very small. If the pressure of the carbon dioxide is 1 atmosphere and the temperature 900–1100°, the equilibrium becomes, $0{\cdot}29Na_2CO_3 + 0{\cdot}29TiO_2 \rightleftharpoons 0{\cdot}71Na_2TiO_3 + xCO_2$; under these conditions of temperature and pressure, the equilibrium between potassium carbonate and titanic anhydride is expressed by—

$$0{\cdot}65K_2CO_3 + 0{\cdot}65TiO_2 \rightleftharpoons 0{\cdot}35K_2TiO_3 + CO_2.$$

Under a pressure of 1 atmosphere and at 650–1100°, carbon dioxide does not replace silica from sodium silicate. A mixture of equivalent quantities of zirconium dioxide and sodium carbonate, when heated by the blowpipe flame, loses 18·9 per cent. of its weight in 2 hours, and when heated for an hour at 900° in a stream of carbon dioxide, takes up 1·43 per cent.

T. H. P

920. *Action of Sodium and Potassium Amalgams on Various Aqueous Solutions.* **G. Fernekes.** (Journ. Phys. Chem. 7. pp. 611–639, Dec., 1903.)—The author has carried out a laborious investigation of the influence of various inorganic salts (in various concentrations) and organic substances on the solution of sodium (in sodium amalgam) in water. Among the salts which accelerated the action of water are: Sodium aluminate, sodium bicarbonate, disodium hydrogen phosphate, sodium sulphite, and sodium hydroxide (from alcohol); among those which retarded the action are sodium bromide, pyroborate, sulphate, chloride, pyrophosphate, iodide acetate, and hydroxide (from sodium). The degree of acceleration or retardation was not strictly proportional to the concentration of the salts. Similarly potassium bicarbonate accelerates the action; potassium iodide, bromide, and sulphate retard the action. Of organic substances a large number were tried. In the case of eleven different hydrocarbons, acceleration was observed, several minutes, however, elapsing before rapid action begins. Acceleration was also observed in the case of glycerine (great), ether (great), methyl, ethyl, and amyl alcohols, thymol, cuminol, camphor, and menthol. Little effect was produced by phenol and by various amino-compounds. To explain the behaviour of these substances, the author adopts the solution theory of Kahlenberg, and assumes that unstable compounds with water are formed which act on the amalgam. No evidence, however, is given of the existence or formation of such compounds.

A. F.

921. *Fluoride of Gold.* **V. Lenher.** (Chem. News, 88. p. 307, Dec. 24, 1903. Paper read before the Wisconsin Academy of Science, Dec. 26, 1902. From the Journal of the American Chemical Society.)—It was not found possible to prepare a fluoride of gold. Freshly precipitated gold oxide is not acted on by hydrofluoric acid or by a mixture of hydrofluoric and nitric acids. Double decomposition of silver fluoride and auric chloride in aqueous solution gives a quantitative yield of auric hydroxide and hydrogen fluoride, $AuCl_3 + 3AgF + 3H_2O = 3AgCl + Au(OH)_3 + 3HF$, and of fourteen organic solvents examined not one was capable of dissolving both silver fluoride and gold chloride, so that the double decomposition could only be tried with aqueous solutions.

T. M. L.

922. *Reciprocal Solubility of Nicotine in Water.* **C. S. Hudson.** (Zeitschr. Phys. Chem. 47. pp. 113–115, Jan., 1904. Königl. Universitäts-Institut für anorg. Chemie, Göttingen, April, 1903.)—The great contraction and evolution of heat occurring on mixing nicotine and water, as well as the great variation of the specific rotation and of the refraction-equivalent in aqueous solution with the concentration, indicate the formation of a hydrate of nicotine. It is probable that the formation of this hydrate, which has not been isolated, conditions the complete miscibility of nicotine and water at certain temperatures—below 60° and above 210°. At high temperatures (about 200°) ordinary glass is strongly attacked and rendered opaque by mixtures of nicotine and water, so that the experiments have to be carried out in the "Durax" glass made at Jena. The results of the author's observations of the temperatures at which mixtures in different proportions of nicotine and water become opaque and transparent again are given both in a diagram and in tables. Solutions containing less than 7·8 or more than 82 per cent. of nicotine remain homogeneous at all temperatures. A 7·8 per cent. solution becomes turbid at 89° and clear again at 155°; below 90° the upper layer, and above 90° the lower layer, is the richer in water, and at 90° the two layers change places. Nicotine cannot be obtained crystalline, even after fractionation in a current of hydrogen and cooling to — 80°. T. H. P.

923. *Dynamical Study of the Friedel-Crafts Reaction.* **B. D. Steele.** (Chem. Soc., Journ. 83. and 84. pp. 1470–1490, Jan., 1904.)—In the reaction between benzoyl chloride and excess of toluene in the presence of aluminium chloride there is an initial stage in which the velocity of the reaction, as measured by the rate of production of HCl, is constant. This can be explained by the formation of an intermediate compound $Al_2Cl_6(Ph.COCl)_2$, which reacts with the toluene according to the equation—

$$Al_2Cl_6(Ph.COCl)_2 + Ph.CH_3 = Al_2Cl_6(Ph.CO.C_6H_4.CH_3)_2 + 2HCl$$

(Perrier, Ber. deutsch. chem. Ges. 33. 815. 1900, and Boeseken, Rec. Trav. chim. Pays-Bas. 19. 19. 1900, and 20. 102. 1901), for the active mass of this intermediate compound will remain constant so long as it is present as a solid phase. After this stage is passed the reaction will become unimolecular, and such was found to be the case, provided the original ratio of aluminium chloride to acid chloride does not exceed unity. In presence of an excess of aluminium chloride the reaction appears in this second stage to be bimolecular, and cannot therefore be explained by the mechanism suggested by Perrier and Boeseken. The bimolecular character of the reaction in this case is probably due to interaction between two intermediate compounds, one containing aluminium chloride and acid chloride, the other aluminium chloride and hydrocarbon. In the above cases the action ceases when all the aluminium chloride is used up to form a constituent of the final product. But when ferric chloride is employed, it is not removed from the system, and acts therefore like a true catalyst. In this case the reaction appears to be bimolecular, and therefore the reacting components are probably intermediate compounds of the ferric chloride with both acid chloride and hydrocarbon. F. G. D.

924. *Alteration of the Specific Conductivity of Salt Solutions by Alkalies.* **R. Ehrenfeld.** (Zeitschr. Elektrochem. 10. pp. 8–9, Jan. 1, 1904. Communication from the Laboratorium des k. k. technische Hochschule in Brünn).—Since the gradual addition of N/10 — N/1000 caustic alkali solution to solutions of salts of most organic acids—not only those containing acid methylene and hydroxyl-groups—produces a diminution in the electrical conductivity of the solutions, it must be concluded that hydrolytic dissociation of the salts takes place, and that this is diminished in amount by the increased number of hydroxyl ions introduced by the alkali. The author gives the results of the examination in this direction of solutions of salts of organic and also of inorganic acids. With the inorganic salts, only in the case of potassium chloride, which is but slightly dissociated, is no diminution of the conductivity produced by the addition of alkali. With solutions of sodium and potassium sulphates N/100 acetic acid and N/100 sodium hydroxide solutions produce similar changes. T. H. P.

925. *Dissociation Constants of Trimethylene-carboxylic Acids.* **W. A. Bone** and **C. H. G. Sprankling.** (Chem. Soc., Journ. 83. and 84. pp. 1378–1380, Jan., 1904.)—An investigation to determine the effect of ring formation on the dissociation constant of an acid. The conductivities, and thence the dissociation constants, of several trimethylene-carboxylic acids are compared with those of the corresponding unsaturated acids containing two hydrogen atoms less, thus:—

Acid.	K.	Acid.	K.
Trimethylene-carboxylic	0·00171	Butyric	0·00149
Trimethylene-1 : 1-dicarboxylic	2·00	Dimethylmalonic	0·0760
cis-Trimethylene-1 : 2-dicarboxylic	0·040	Methylsuccinic	0·00854
trans-Trimethylene-1 : 2-dicarboxylic	0·0205		

In each case the value for the trimethylene acid is the higher, particularly for the last three, so that a "trimethylene" formation in the succinic acid series will probably be accompanied by a marked increase in the conductivity. W. H. Si.

926. *Studies on Comparative Cryoscopy.* Part I. *The Fatty Acids and their Derivatives in Phenol Solution.* **P. W. Robertson.** (Chem. Soc., Journ. 83. and 84. pp. 1425–1440, Jan., 1904.)—The author has carried out a large number of experiments on the influence of constitution on the rate of association, *i.e.*, change of association for a given range of concentration, in phenol solution. The general conclusions which he draws from his experiments are: (1) In freezing phenol the fatty acids and their derivatives tend to associate with an increase of the concentration. (2) The "rate" of association of the normal fatty acids alternately increases and decreases. If the compounds containing an even number of carbon atoms are considered, the association decreases until a minimum is reached at the sixth member; the subsequent increase is rapid. (3) The influence of substituents depends on their nature and on their position, as well as on the acid into which they are introduced. But it is a general rule that α-disubstituted acids associate less strongly than the mono-derivatives, whilst trisubstituted acids exhibit the lowest rate of association. (4) Dicarboxylic acids associate more rapidly than monocarboxylic acids. Here, again, substitution in the α-position reduces the rate of association. (5) α-Hydroxy- and isonitroso-groups tend to increase the rate of association. (6) Certain nitrogen-groups have a negative influence, *i.e.*, the resulting compounds have molecular weights decreasing with the concentration. (7) The rate of association of the substituted acetic acids bears a qualitative relationship to their velocity of esterification. A. F.

927. *Acid Salts of Monobasic Acids.* **R. C. Farmer.** (Chem. Soc., Journ. 83. and 84. pp. 1440–1449, Jan., 1904.)—The author has examined the following salts: Hydrogen ammonium benzoate, hydrogen potassium *m*-toluate, hydrogen ammonium *m*-toluate, hydrogen potassium *p*-toluate, hydrogen ammonium *p*-toluate, hydrogen potassium *o*-bromobenzoate, hydrogen ammonium *o*-bromobenzoate, hydrogen potassium *m*-bromobenzoate, hydrogen ammonium *m*-bromobenzoate, hydrogen potassium *p*-bromobenzoate, hydrogen ammonium *p*-bromobenzoate, hydrogen potassium *o*-nitrobenzoate (with alcoholic ammonia *o*-nitrobenzoic acid yielded only the normal salt), hydrogen potassium *m*-nitrobenzoate, hydrogen ammonium *m*-nitrobenzoate, hydrogen potassium *p*-nitrobenzoate, hydrogen ammonium *p*-nitrobenzoate, hydrogen potassium salicylate, hydrogen potassium *p*-hydroxybenzoate, hydrogen ammonium *p*-hydroxybenzoate. When these acid salts were treated with water they were at once decomposed, and by means of determinations of the distribution coefficient, the author concludes that there is no evidence for the existence of acid acetates or benzoates in aqueous solution. When a small quantity of mineral acid was added to a concentrated solution of potassium benzoate, the precipitate was not pure benzoic acid but hydrogen potassium benzoate. The double salts can be crystallised from alcohol without change. Experiments showed, however, that even in alcoholic solution the double salt is for the most part dissociated into free acid and normal salt. A. F.

928. *On the Equilibrium* $Mg(OH)_2 + 2NH_4Cl \rightleftharpoons MgCl_2 + 2NH_4OH$. **W. Herz** and **G. Muhs.** (Zeitschr. Anorg. Chem. 38. 2. pp. 138–141, Jan. 18, 1904. Chem. Institut der Universität, Breslau, Oct. 31, 1903.)—Lovén showed, a number of years ago, that when magnesium sulphate is shaken with ammonium hydroxide, an equilibrium is obtained in agreement with the law of mass action. The authors have studied the equilibrium when approached from the opposite side, by shaking magnesium hydroxide with solutions of ammonium chloride of different concentrations. In this way they also obtained equilibrium constants in agreement with the law of mass action. The results obtained with ammonium nitrate are, however, not so good. These experiments were undertaken because previous experiments carried out in the same way with hydroxides of manganese, zinc, and cadmium were not in agreement with Guldberg and Waage's law. A. F.

929. *Chemical Nature of Colloidal Solutions.* **J. Duclaux.** (Comptes Rendus, 138. pp. 144–146, Jan. 18, 1904.)—The author considers that in studying colloidal substances, their chemical nature, and not merely their physical structure, should be taken into account. On mixing a dilute solution of potassium ferrocyanide with one of a copper salt, the copper ferrocyanide formed may, according to the conditions, either remain in suspension or coagulate, but in all cases it contains potassium. The anion of the copper salt does not go into the precipitate which has the composition $Fe(CN)_6Cu_mK_n$, where $m + n/2 = 2$; with increasing quantities of copper salt, n varies from 1·3 to nearly 0. In the cases of copper and cadmium sulphides, the anion also passes into the precipitate. Colloidal solutions can be prepared which are very near their critical coagulation point and in which the addition of very small quantities of one of the salts present produces a precipitate. Since the precipitate has a different composition from the colloidal solution, the coagulation cannot be referred to merely physical causes. T. H. P.

930. *Influence of Non-electrolytes and Electrolytes on the Degree of Dissociation.* **M. Wilderman.** (Zeitschr. Phys. Chem. 46. pp. 43–63, 1903. Davy Faraday Laboratory of the Royal Institution, London, Jan. 20, 1903.)—The values of the depression of the freezing-point of water by *o*-nitrobenzoic acid and dichloroacetic acid in dilute solution agree well with those calculated from the conductivities. In the two most concentrated solutions, 0·0510N dichloroacetic acid and 0·0162N *o*-nitrobenzoic acid, gradually increasing proportions of the water were replaced by a solution of glycerin, of which 10 c.cm. lowered the freezing-point about 0·014°; the observed depressions in the mixed solutions agreed well with those calculated additively. The molecular depression for glycerin up to a concentration of 0·08N is constant and independent of the presence of acids of medium strength. The dissociation of these acids is not altered by the addition of glycerin, so that the diminution of conductivity remarked by some observers must be explained by changes in the viscosity and in the mobility of the ions. Mixed solutions of nitric and *o*-nitrobenzoic acids were also examined cryoscopically. The nitric acid solutions employed were very dilute, and the minute changes in the degree of dissociation, owing to the presence of common ions, were calculated by an approximate formula. The observed depressions of freezing-point agreed well with the calculated values.

T. H. P.

931. *Formation and Saccharification of "Retrograded" Starch.* **L. Maquenne.** (Comptes Rendus, 138. pp. 213–214, Jan. 25, 1904.)—If a series of "solutions" of starch of different concentrations be kept for four days at 9°, and then subjected to the action of malt extract, the percentage of unsaccharifiable amylo-cellulose formed is found to be relatively greater, the greater the concentration of the original starch solution. Rise of temperature (below 70° C.) diminishes the amount of unsaccharifiable material in a mixture of retrograded starch solution and malt extract. From these and previous observations [see Abstract No. 448 (1904)] the author concludes that the so-called amylo-cellulose is not a pure substance but a mixture of several condensation products of the starch molecule, which are characterised by giving no colour-reaction with iodine and by offering a resistance to the solvent influence of amylase. F. G. D

932. *Amalgams.* **W. Kettembeil.** (Zeitschr. Anorg. Chem. 38. 2. pp. 213–231, Jan. 18, 1904. Extract from Göttingen Dissertation. Institut für physikalische Chemie, Göttingen, Oct., 1903.)—The author divides the metals into three groups of which one, including especially the alkaline and alkaline earth metals, have a very great tendency to form amalgams, and a second group, including iron, cobalt, nickel, and platinum, will not amalgamate, whilst an intermediate group, including aluminium and magnesium, occupy an intermediate position and yield amalgams of no great stability. Experiments with salts of the rare earths showed that none of these formed amalgams when electrolysed with a mercury kathode; in the case of the salts of the alkalies, amalgam begins to be formed when the polarisation at the kathode is above 1·4 volts, but unless a high-current density is used, the amalgam decomposes as rapidly as it is formed. In the case of salts of Na, Ba, and Mg, the tension at the kathode is not reduced by using mercury in place of platinum. The fact that potassium amalgam can be prepared by the action of sodium amalgam on caustic potash has already

been noticed, but sodium amalgam can also be prepared by the action of potassium amalgam on caustic soda, and the action appears therefore to be a reversible change, in which a condition of equilibrium between the two amalgams would ultimately be reached. T. M. L.

933. *Role of Formation Heats of Alloys.* **J. W. Richards.** (Electrochem. Ind., N.Y., 1. pp. 575–576, Dec., 1903.)—The following table shows the heat absorbed in the decomposition of the copper-aluminium alloys: (I.) If Cu only is dissolved, going into solution as cuprous salt. (II.) If Cu only is dissolved, going into solution as cupric salt. (III.) If Al only is dissolved. (IV.) If the whole alloy is dissolved, the Cu dissolving as cuprous salt. (V.) If the whole alloy is dissolved, the Cu dissolving as cupric salt.

Alloy attacked.	I.	II.	III.	IV.	V.
Cu_3Al	4,485	8,970	8,970	2,990	4,485
Cu_2Al	5,320	10,640	7,093	3,040	4,258
Cu_3Al_2	2,900	5,800	2,900	1,450	1,835
Cu Al	943	1,887	629	377	472
Cu_2Al_3	2,549	5,098	1,133	784	927
Cu Al_2	3,369	— 6,738	— 1,123	— 842	— 964

T. M. L.

934. *Cause of Change of E.M.F. of Daniell Cell with Concentration.* **H. S. Carhart.** (Electrochem. Ind., Philadelphia, 1. pp. 178–179, Jan., 1903. "Die Normalelemente," p. 29.)—The author accounts for the change by the fact that the thermo-e.m.f. between a metal and a solution increases with the concentration of the solution. To prove this point further (as against the explanation of Richards that the effect is due to variation of heat of formation with concentration), the author experimentally determined the difference of e.m.f. between cells containing N/16 and N-$ZnSO_4$. This difference is 0·021 volt. Taking the thermo-e.m.f.'s per degree of the two solutions coupled with zinc, and multiplying by the absolute temperature, 0·029 volt is obtained, which agrees fairly with the above. It is an interesting fact that the difference of the e.m.f. of the two Daniells is equal to the e.m.f. of the concentration cell formed with the two solutions. This is not in agreement with Nernst, who concludes that the e.m.f. of the concentration cell is to the difference of the two Daniells as the ionic velocity of the anion is to the sum of the ionic velocities of the anion and the kation. W. R. C.

935. *Law of E.M.F.'s in Liquid Cells.* **Berthelot.** (Comptes Rendus, 136. pp. 413–426, Feb. 16, and pp. 481–485, Feb. 23, 1903.)—The author states the following law: The e.m.f. due to the junction of an acid and a base is equal to the sum of the e.m.f.'s due to the junctions of the corresponding salt with the acid and with the base. This is proved by setting up cells in opposition in a chain ending with non-polarisable electrodes, and also by measuring the component e.m.f.'s. The law is independent of temperature and holds approximately even when the solutions are concentrated. [See also Abstract No. 656 (1904).] W. R. C.

936. ***Influence of Persulphates on the Catalytic Decomposition of Hydrogen Peroxide by Colloidal Platinum.*** **T. S. Price** and **A. D. Denning.** (Zeitschr. Phys. Chem. 46. pp. 89–102, 1903. The University, Birmingham.)—Potassium and ammonium persulphate solutions are not decomposed by colloidal platinum, but they accelerate the decomposition of hydrogen peroxide both in neutral and in sulphuric acid solutions. When potassium persulphate solution and freshly-prepared colloidal platinum solution are added simultaneously to the hydrogen peroxide, the increase in the velocity of decomposition of the latter is proportional to the amount of persulphate added. Decreasing the concentration of the sulphuric acid employed increases the decomposition velocity. The decomposition of the peroxide takes place about double as quickly in a neutral solution as in one containing acid, but the acceleration produced by the persulphate is the same in the two cases. When potassium persulphate and hydrogen peroxide are brought into contact without platinum, the peroxide undergoes much more rapid decomposition, but the velocity constant diminishes very rapidly, because the persulphate acts on the peroxide not only catalytically, but also in the same way as permanganate, only less rapidly. If in presence of platinum, persulphuric acid is used instead of the potassium salt, the constant diminishes to a still greater extent and in two or three hours falls to half its original value. The persulphuric acid accelerates the decomposition of the peroxide, but the initial value of the constant is greater the smaller the concentration of the free acid. The acceleration of the decomposition of hydrogen peroxide by free persulphuric acid is accompanied by decomposition of the acid, which probably enters into reaction with the peroxide, forming Caro's acid.

T. H. P.

937. *Catalytic Oxidation of Organic Substances by Means of Concentrated Sulphuric Acid. I. Contributions to the Chemical Kinetics of the Kjeldahl Analysis and the Oxidation of Naphthalene.* **G. Bredig** and **J. W. Brown.** (Zeitschr. Phys. Chem. 46. pp. 502–520, 1903. Extract from the Inaugural Dissertation of J. W. Brown, Heidelberg, 1903.)—The velocity of oxidation of naphthalene and aniline sulphate by means of concentrated sulphuric acid at a temperature of 275° C. was found by measuring the volume of the mixed carbon dioxide and sulphur dioxide evolved. An investigation of the ratio of the volume of carbon dioxide to that of sulphur dioxide showed that the oxidation of the aniline sulphate corresponded to the equation—

$$(C_6H_5NH_2)_2 \cdot H_2SO_4 + 28H_2SO_4 = (NH_4)_2SO_4 + 28SO_2 + 12CO_2 + 32H_2O,$$

whereas in the case of naphthalene the oxidation only seems to proceed as far as phthallic acid, according to the equation—

$$C_{10}H_8 + 9H_2SO_4 = C_6H_4(COOH)_2 + 9SO_2 + 2CO_2 + 10H_2O,$$

except in the presence of catalytic agents, when part of the naphthalene is probably oxidised further still. In both cases the reaction is approximately of the first order, but side reactions occur which complicate it. The catalytic effects of mercury were especially studied. The acceleration was found to be proportional to the quantity of mercury; ½ per cent. of mercury trebled the reaction velocity. Small quantities of water had no effect; neither did it matter whether the mercury was used as mercurous or as mercuric sulphate. The temperature-coefficient between 200° and 300° C. was of the usual order, both with and without the catalyser; at higher temperatures the influence of the catalyser is less marked. Copper sulphate was also found to be a good catalytic agent. The following table gives the relative effects of different salts. Equivalent quantities of the salts were used, and the time found for the evolution of 24 c.cm. of gas, using aniline sulphate. Without the addition of a catalyser 208 min. were necessary. The times are given in minutes. Mercurous sulphate, 13·8; copper sulphate, 17·3; ferrous sulphate, 142; nickel sulphate, 160; potassium sulphate, 170; cobalt sulphate, 172; magnesium sulphate, 183; phosphorus pentoxide, 198; manganese sulphate, 200; cadmium sulphate, 221. Potassium sulphate and phosphorus pentoxide do not act catalytically, but simply afford a means of raising the temperature of reaction. Copper is less active than mercury in the oxidation of naphthalene, the times for the evolution of the same volume of gas being 41 and 126 min. respectively. Thus the action of a catalyser depends on the reaction. It was also found that the acceleration produced by a mixture of mercurous and copper sulphates was much greater than the sum of the individual accelerations. T. S. P

938. *Heterogeneous Catalytic Reactions. I. Knallgas Catalysis by means of Platinum.* **M. Bodenstein.** (Zeitschr. Phys. Chem. 46. pp. 725–776, 1903. Physikalisch-Chemisches Institut, Leipzig.)—The author measures the velocity of the formation of water from "Knallgas," or Knallgas mixed with an excess of either of the components, under the catalytic influence of a platinum surface which is kept cool by a circulating current of water. The velocity is measured by observing the alteration in pressure at constant volume. If the platinum surface is quite clean and pure, the reaction proceeds at ordinary temperature with a velocity which can readily be measured. If the water formed is allowed to condense on the platinum, the reaction is approximately of the first order, no matter whether the reaction mixture is Knallgas or Knallgas mixed with an excess of either component. This can be explained on the assumption that the process really measured is the velocity of solution of the oxygen, in exceptional cases that of the hydrogen, by the layer of water on the surface of the platinum, the union of the gases taking place at or in the surface of the platinum with infinite velocity. The velocity of solution of oxygen is less than that of hydrogen, and thus governs the velocity of the reaction. As the reaction proceeds, the constants increase considerably, possibly because the union of the gases does not actually take place with infinite velocity; this is supported by the fact that the less active the platinum the greater is the increase in the value of the constants. In the case where oxygen is in excess the constants gradually decrease. The temperature-coefficient is very small, 1–2 per cent., as is the case in physical processes, and this adds further support to the assumption that the process really measured is a physical one. As the temperature increases, the increase in the constants is not so marked, since the increase with the temperature of the velocity of combination is greater than the increase in the velocity of solution of the oxygen. If the platinum is kept warmer than its surroundings, it remains dry during the reaction. The velocity is then very much increased, and does not even approximate to an equation of the first order. The results are then best explained by assuming that the velocity measured is that of the solution of the oxygen in the platinum, but the reaction is complicated by the retarding effect of the stream of water vapour proceeding from the surface of the platinum, the diffusion of the Knallgas to the surface thus being hindered. The temperature-coefficient is again small, about 8 per cent. The constants increase in all cases, even when oxygen is present in excess. Since the velocity depends only to a small extent on the concentration and temperature, it cannot be altered much by alteration of these variables. It can be decreased, however, by

poisoning the platinum; the results then obtained approximate more closely to an equation of the first order. Iodine is the best poisoning agent. The author shows that Brunner's theory of heterogeneous reactions can be applied to the present reaction. From his experiments the author calculates that the velocity of solution of oxygen in the layer of water on the platinum is 1·6 c.cm. per sq. cm. water surface per minute, and that the velocity of diffusion of the oxygen is 0·0048 c.cm. per cm. per min. [See also Wegscheider, Abstracts Nos. 886 (1900) and 898 (1901).] T. S. P.

939. *Electrolysis of Alkali Sulphides.* **A. Brochet** and **G. Ranson.** (Comptes Rendus, 136. pp. 1134–1136, May 11, 1903.)—The authors have confirmed the results obtained by other investigators—that when a dilute solution of an alkali sulphide is electrolysed, the sulphide is oxidised to hyposulphite and sulphate. When, however, concentrated solutions are electrolysed at temperatures between 50° and 70°, sulphur is formed at the anode and caustic soda and hydrogen at the kathode. The sulphur which is thus liberated dissolves in the concentrated solution of sulphide forming polysulphides, but as the solution becomes richer in sulphur, combination between this and the kathodic hydrogen takes place (when no diaphragm is employed) with regeneration of sulphide. One therefore obtains the reversible reaction $Na_2S + 2H_2O \rightleftharpoons 2NaOH + H_2 + S$. When a diaphragm is employed, the change from right to left does not occur. When concentrated solutions are electrolysed with a diaphragm, the reaction at the anode is at first the same as above; but when the concentration of polysulphides increases sufficiently, these compounds undergo decomposition, sulphur being deposited and oxidation products being formed. Addition of sodium chloride to the solutions does not alter the reactions; but in such a case iron, nickel, or copper cannot be employed as anodes. [See also next Abstract.] A. F.

940. *Electrolysis of Barium Sulphide using a Diaphragm.* **A. Brochet** and **G. Ranson.** (Comptes Rendus, 136. pp. 1258–1260, May 25, 1903.)—When a concentrated solution of barium sulphide is electrolysed with the use of a porous diaphragm, the reaction is in the first instance the same as when no diaphragm is employed. [See preceding Abstract.] The baryta, however, formed at the kathode diffuses into the anode space, and being without action on the polysulphides present, separates out on cooling. In this way almost the whole of the baryta could be recovered. The authors find that the yield of baryta is 2 kg. per kw.-hour. The authors point out that the electrolysis of barium sulphide gives a method of manufacturing baryta with small expenditure of energy. A. F.

941. *Electrolytic Separation of Metals.* **Hollard** and **Bertiaux.** (Comptes Rendus, 136. pp. 1266–1268, May 25, 1903.)—Sulphurous acid is made use of in the separation of iron from manganese, iron from aluminium, and zinc from iron. In the first case, to a solution of the metals in the form of sulphates, containing a few drops of free H_2SO_4, are added 5 gm. of citric acid, 25 to 50 c.cm. (according to the quantity of iron) of a saturated solution of SO_2, and 25 c.cm. of ammonia (22° B). The solution is then neutralised by the addition of H_2SO_4, and finally rendered alkaline with a few c.cm. of ammonia. The iron from this solution (brought to a volume of 300 c.cm.) is deposited on a gauze kathode of large area, the anode being a spiral of platinum wires of

small area. With a temperature of 48° C. and a current of 1 ampere the deposition of the iron is complete before the appearance of manganese peroxide on the anode. The manganese is next separated as peroxide on a gauze anode of large area by electrolysing the solution, thus freed from iron, at a temperature of 90–95° C., with a current of 1 ampere, the above platinum spiral being used as kathode. The amount of peroxide adhering to the anode and that which falls to the bottom of the cell is estimated volumetrically. The method of separating iron from aluminium is similar to the above, but in the case of separating zinc from iron, the iron is first reduced to ferrocyanide of potassium, and SO_2 added. The zinc is then deposited alone with a current of 0·3 ampere. [See also Abstract No. 1512 (1903).]

J. D. C.

942. *Electrolytic Separation of the Alkaline Earth Metals.* **A. Coehn** and **W. Kettembeil.** (Zeitschr. Anorg. Chem. 38. 2. pp. 198–212, Jan. 18, 1904. Institut für physikalische Chemie, Göttingen, Oct., 1903.)—According to Nernst's formula, $\epsilon = \frac{RT}{n} \log_e \frac{C}{c}$, the potential necessary to deposit a metal from its solution depends both on the ionic concentration and on the solution tension of the metal. The former can be altered by the formation of complex ions, and the latter by lowering the partial pressure of the metal at the kathode—as, for instance, by the formation of an amalgam. The latter method was used by Davy and Berzelius for the preparation of the alkali and alkaline earth metals. From preliminary experiments the authors have come to the conclusion that the alkaline earth metals could be separated by fractional electrolysis. To learn the necessary conditions for the separation, they electrolysed saturated solutions of the chlorides of Ba, Sr, and Ca, using varying potentials, in order to find the current yield in each case. By this means they were able to find out the potential at which a definite yield was obtained, *i.e.*, when the velocity of deposition of the metal became greater than the velocity of decomposition of the amalgam by the water. This was deduced from the experimental curves showing the relation between potential and current strength, there being a break in the curve at the point where the formation of the amalgam commences. The differences in the potentials at the point where the formation of the amalgam begins were found to be Ba/Sr : 0·2 volt; Sr/Ca : 0·25 volt; Ba/Ca : 0·45 volt. These numbers hold for the saturated solutions of the respective chlorides, and when it is borne in mind that these concentrations are very different, it will be seen that with equivalent solutions the differences in potential will be still greater. The authors have found, by actual experiment, that Ba could be deposited from a mixture of Ba and Sr, even when the Ba was in great excess, without the deposition of a trace of Sr. Sr and Ca could be separated in a similar manner. Since the difference in potential between Ba and Ca is still greater, it follows that these metals could be separated still more easily.

T. S. P.

943. *Iron Salts in Voltameter Solutions.* **J. M. Bell.** (Journ. Phys. Chem. 7. pp. 652–655, Dec., 1903.)—Elbs has shown that the presence of iron in the sulphuric acid solution of an oxyhydrogen voltameter decreases the amount of gas evolved [see Abstract No. 423 (1901)]. On the other hand, Schwab and Baum [see Abstract No. 476B (1904)] show that the effect of iron in the copper voltameter is negligible. The author's explanation is as follows: In

the oxyhydrogen voltameter platinum electrodes are used, and these remain unchanged, while in the copper voltameter there is a soluble anode. The oxygen formed at the anode in the first case oxydises ferrous sulphate to the ferric condition, thus reducing the amount of gas evolved, while copper going into solution has no such effect. Also, in the first case the amount of hydrogen evolved is diminished by its reducing action on the ferric sulphate, whereas in the copper voltameter no ferric sulphate is produced, except by oxidation by the air, and such oxidation is very slow. This explanation is supported by the following experiments: (1) Two oxyhydrogen voltameters with platinum electrodes were placed in series, one containing a 10 per cent. sulphuric acid solution, and the other sulphuric acid and ferrous sulphate.

Per cent. Fe as $FeSO_4$ in solution.	Current density. Amperes per sq. decimetre.	Per cent. decrease in oxyhydrogen gas.
1·0	1·0	29·5
1·0	0·5	39·7
1·0	0·2	53·0

The less the current the greater is the percentage decrease, as was to be expected. This agrees with the results of Elbs, but the percentage decrease is less, since the iron at the beginning of the experiment was all in the ferrous state. (2) Three cells in series: A, a copper voltameter; B, a cell with copper electrodes and iron in the electrolyte; C, a cell with platinum electrodes and iron in the electrolyte.

Current density. Amperes per sq. decimetre.	Kathode gain. A.	Kathode gain. B.	Kathode gain. C.	Efficiency. B.	Efficiency. C.
1·0	1·794 gm.	1·781	1·642	0·993	0·915
0·5	1·185	1·182	0·997	0·997	0·841
0·2	1·543	1·533	1·045	0·994	0·679

Thus the efficiency in the cell with the soluble anode is over 99 per cent.

T. S. P.

944. *Electrolytic Estimation of Small Quantities of Silver in Presence of Lead.* **Arth** and **Nicholas.** (Chem. News, 88. pp. 309–310, Dec. 24, 1903.)—By employing a maximum of 1·1 volts on an open circuit and heating to 60° C., it is found possible to separate silver completely from lead in nitric acid solution, even when the proportion of silver to lead is as low as 1 : 100,000, the silver being completely deposited on the kathode. To obtain accurate results, the above electromotive force and temperature must be adhered to, and the amount of free nitric acid present should not fall below a minimum of 1 per cent. of the total volume of liquid, 6 c.cm. of alcohol at 95° being also added. The duration of the operation is about seven hours, a sufficient length of time being specially important when extracting the silver from much liquid, in which case the solution must also be frequently stirred. With 1·2 volts the silver tends to deposit in spongy condition, and if too little acid is added, a small amount of lead is deposited with the silver. The process works well for the estimation of silver in sheet lead, which is first dissolved in nitric acid and evaporated to dryness, then dissolved in water, and electrolysed. The presence of a small quantity of copper does not interfere at all, not being deposited with such a low e.m.f. W. H. St.

945. *Electrolytic Preparation of Nitrites from Nitrates.* **W. J. Müller.** (Zeitschr. Elektrochem. 9. p. 978, Dec. 17, 1903.)—For the electrolytic preparation of nitrites from nitrates, amalgamated copper electrodes give the best results. As the yield increases with the concentration, the author employs a hot saturated solution of sodium nitrate at a temperature of 80–90°, the current density being 0·005 – 0·01 ampere per sq. cm. The current yield of nitrite is good up to a point when 30 per cent. of the nitrate is reduced. The yield is not improved by the previous addition of nitrite to the solution. The nitrate and nitrite cannot be separated by fractional crystallisation, so that the electrolytic preparation of nitrite is of no technical importance. T. H. P.

REFERENCES.

946. *Transport Numbers of very Dilute Solutions.* **B. D. Steele** and **R. B. Denison.** (Chem. Soc., Journ. 81. and 82. pp. 456–469, April, 1902.)—There are experimental difficulties in measuring transport numbers of dilute solutions. The authors overcame these by using a special form of apparatus, in which the central portion of the electrolyte between the electrodes could be removed at intervals. The time varied from seven to thirty-six hours with a voltage of 170 to 180. The concentration varied from $n = 0{\cdot}00529$ to $n = 0{\cdot}0025$. It is probably impossible to work with lower concentrations owing to the conductivity of water. Normal results were obtained at these dilutions. W. R. C.

947. *Electrolysis of Water.* **W. R. Whitney.** (Journ. Phys. Chem. 7. pp. 190–193, March, 1903.)—A short discussion of the paper by Bigelow [see Abstract No. 683 (1904)], in which the idea was put forward that current at low voltages was carried by the dissolved gases instead of by the usual ions. The author claims that the Nernst equation is sufficient to account for the phenomena, the electrodes being considered as gas electrodes of low gas concentration, and the e.m.f. being different for each different pressure of the gas. W. R. C.

948. *Application of Physical Chemistry to the Agglutinins.* **S. Arrhenius.** (Zeitschr. Phys. Chem. 46. pp. 415–426, 1903.)—The author has applied the law of mass action to the agglutination of bacteria by agglutinin (serum). He shows that the equation $C = \text{const.} \times B^{\frac{2}{3}}$ (where C = combined agglutinin, B = free agglutinin) holds when the amount of bacteria is kept constant. The author also discusses the process of absorption of agglutinin by the bacteria. A. F.

949. *Relation of Volume E.M.F. and Pressure in Cells.* **R. R. Ramsey.** (Phys. Rev. 16. pp. 105–111, Feb., 1903.

950. *Observations on the System: Zinc Chloride, Sal-ammoniac, and Water.* **P. A. Meerburg.** (Zeitschr. Anorg. Chem. 37. 1. pp. 199–222, Oct. 27, 1903.)—Schreinemaker's method, consisting in the analysis of mixtures of three components, without the precipitated body being separated, by means of an analysis of the solution, the complex and the remainder, has given excellent results. Out of the eight double compounds of $ZnCl_2$, NH_4Cl and H_2O, there are only two capable of existing, namely, $ZnCl_2 2NH_4Cl$ and $ZnCl_2 3NH_4Cl$. Though hydrates may be capable of existing at very low temperatures, they do not exist at ordinary temperatures. A. G.